AGRICULTURE RECONSTRUCTION AND DEVELOPMENT PROGRAM FOR IRAQ

STRATEGY FOR WATER AND LAND RESOURCES IN IRAQ
Phase 1 Project Completion Report
Volume 1 - Main Report and Executive Summary

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STRATEGY FOR WATER AND LAND RESOURCES IN IRAQ
Phase 1 Project Completion Report

Volume 1 - Main Report and Executive Summary

Executive Summary

The SWLRI Project

The Strategy for Water and Land Resources in Iraq (SWLRI) project was initiated at the request of the Ministry of Water Resources (MoWR) in May 2005. The Phase 1 project was launched in July 2005 with funding from USAID, as a component of their Agriculture Reconstruction and Development in Iraq Program (ARDI), after a period of preparation facilitated by ARDI during which a draft Work Plan passed through a number of iterations before being finalised at a workshop in Amman in June 2005 attended by stakeholder ministries, representatives of USAID and ARDI. The Phase 1 project was scheduled for completion in September 2006.

The overall long term objective of the strategic planning effort is to provide a sound and comprehensive basis for Iraq's management and development of its water and land resources over the next few decades, together with a framework and methodology for ongoing updating of plans. For Phase 1 the objective was to lay the foundations by focussing on three key areas:

- Assembling the baseline data required for informed decision making
- Developing a 'toolkit' for planners tailored for the specific needs of Iraq
- Building up the capacity of the Iraqi ministries, especially the MoWR, in support of the introduction of modern planning techniques in the water sector.

MoWR initiated a Steering Committee for SWLRI which held four meetings during Phase 1. Eleven ministries are represented on the Steering Committee bringing together all the key government stakeholders.

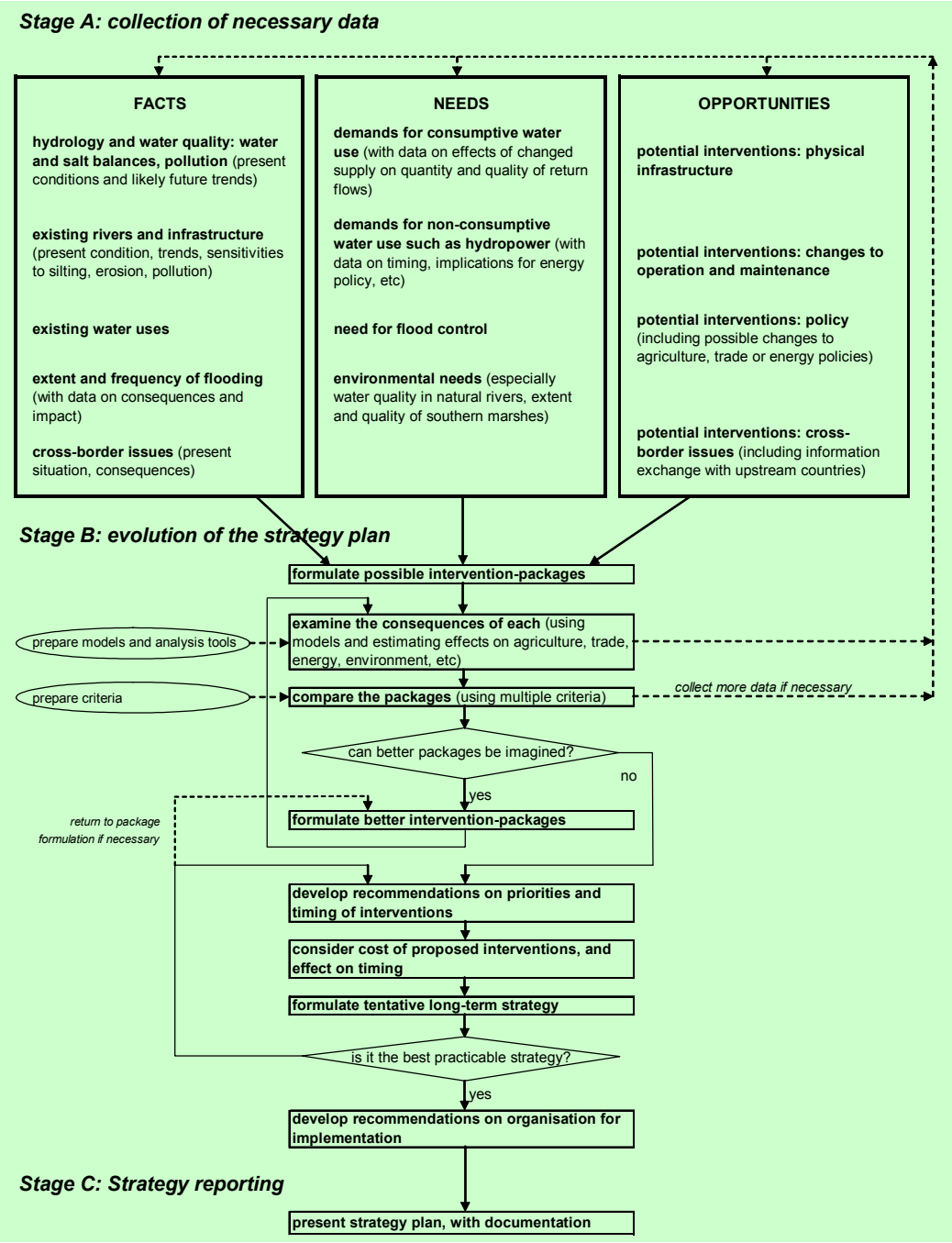
MoWR have also established a SWLRI Unit and the Phase 1 project has provided office accommodation and equipment.

The Phase 1 Completion Report provides a status update on progress and sets out an initial scope of work for the second phase for the MoWR to take forward with potential donors.

Planning Approach

Figure 1 presents a diagrammatic representation of the proposed overall approach to the development of the Strategy for Water and Land Resources in Iraq, both in Phase 1 and thereafter.

Figure 1: SWLRI Planning Approach



The proposed approach has the following particular features:

- It emphasises a distinction between facts and needs: facts about the present state of the country's water resources and its physical infrastructure (both natural channels and man-made infrastructure), and on the other hand needs and desires for water use, flood control and environmental conditions.
- It emphasises, alongside facts and needs, a third data set concerning opportunities for the future; these include not only potential physical interventions like completing the Bekhme

Dam but also policy changes like a shift to different crops on irrigated land, a changed way of using hydropower stations within the national energy sector, or a different way of interacting with upstream countries.

- It emphasises interventions, and packages of interventions, as units of the planning process.
- It emphasises the iterative nature of the evolution of a strategy plan.

The approach is thus based on three data sets – not only facts about the present situation and forecasts of need and demand, but also opportunities for intervention. These data sets would then become permanent features of the ongoing planning process; they would be updated continually or periodically, and would form the basis of revisions of the water resources strategy.

Phase 1 has focussed on Stage A and made a start on Stage B (Figure 1), particularly the preparation of models and other tools. By providing worked examples of the processes illustrated in Figure 1 the consultants will help the MoWR staff to build their capacity to take the process forward – and to develop the national strategy in later phases.

A strategy is usually taken to be the top level in the planning process, where broad targets are established. This requires setting out general concepts and defining generic approaches to address the targets.

A good strategy can be encapsulated in a few pages. It needs three elements:

- A statement of what is to be achieved, namely:
  - The overall targets which the strategy aims to meet
  - Broad details of the preferred or intended method of implementation.
- Commitment of appropriate resourcing. In this sense, resourcing covers all components necessary to implement the strategy. Thus, as well as the more obvious elements of staff and financing, it includes legislation (and changes to this), institutional facilities (such as granting of permits), fiscal measures if appropriate, etc.
- A statement providing the context in which the strategy was developed and establishing the main premises on which it is based. It will then be clear should these factors change, that the strategy itself will need to be revisited. The statement should also include a view on what is envisaged after the period for which the strategy has been developed. This must not be a prescriptive statement but is used to reinforce the statement on context.

The two main tools for implementing a strategy are:

- An action plan, containing a series of sub-plans each focused on specific elements for implementing the strategy. Some of these may be focused on the short term, others medium to long term.
- A complementary financing plan.

Considerable guidance has been developed by both national institutions and international bodies to aid those engaged in planning activities. These are set at different levels of complexity and range from high-level planning to activities associated with detailed planning of project implementation. The aim in Phase 1 of SWLRI has been to select appropriate methodologies and where necessary develop bespoke models and analytical tools to assist the Ministry in its efforts to develop a new strategy.

A Planners Toolkit

Just as a workman's tool box contains a variety of implements so the SWLRI planners toolkit is made up of a number of types of tools and within a particular type there may be several items, some of general use, some very specific. Some tools have been developed during Phase 1. In addition, tools that have been prepared by others have been included in the toolkit where they are highly relevant to the SWLRI objectives.

The toolkit should continue to develop in the future.

The toolkit presently contains four types of tools:

- Reference material: relevant reports and papers, links to web sites, best practice examples etc
- Software: modelling packages, bespoke models, and their associated manuals
- SWLRI technical reports and guidance notes
- SWLRI templates and worked examples.

The development of bespoke models has been a key part of Phase 1 and these are highlighted below.

The SWLRI technical reports and guidance notes form the start of a series of occasional publications addressing issues relevant to strategic planning for the sustainable use of the water and land resources of Iraq.

The distinction between the two series is on the basis of function: technical reports describe work undertaken, discuss results, and make recommendations, while guidance notes are highly focussed, often short, documents that give advice, instructions, and warnings on how to use a model or technique and to interpret the results. Generally there is a guidance note to accompany any modelling software developed for SWLRI.

The Phase 1 toolkit contains six such technical reports – covering the development of various models of the water resources system; with 10 guidance notes in preparation.

Wherever possible MoWR staff have been involved in the development of both the tools and the associated documentation.

The SWLRI templates have been developed to cover specific processes where a consistent, standardised approach is required, for example:

- Collection of information on opportunities
- Generic data quality control procedures.

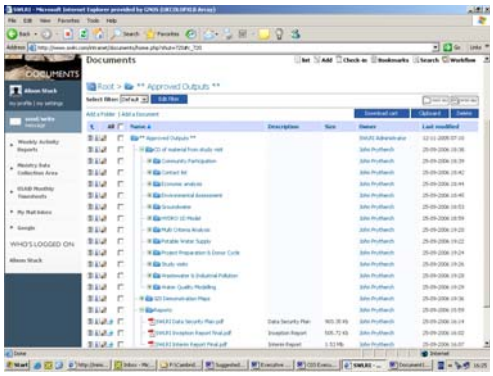
Web-based Collaboration

At an early stage in the project it was decided that a web-based collaboration system was essential to the proposed data collection activities, and would be a tool for helping to build strong links between the stakeholders and to provide opportunities for other ministries to benefit from the project's

activities. In particular the contents of the planners toolkit could be uploaded and made available to all participating bodies: ministries and their consultants.

Claromentis, was selected to act as the project data repository and email system. To encourage participation and eventual data sharing Claromentis has been designed to give each ministry a secure extranet area which has been customised for them. In this area set aside for them, each ministry is able to manage its own data.

The intention was to set up a series of areas on the site to provide easy access to planning tools, guidance notes and reference material as well as the raw data repository.

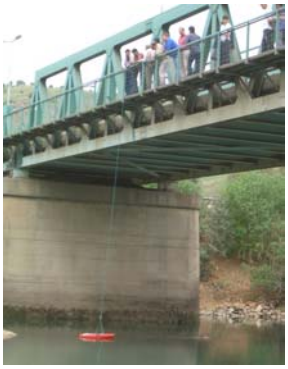


During Phase 1, the password-protected Claromentis system was customised to meet the needs of the principal users and was rolled out for use by authorised individuals. It has been used considerably, particularly as a repository of information and as a facility for managing this. The system will benefit from further fine-tuning to take account of the content uploaded and how the system is being used.

Data Collection

An extensive data collection exercise has been undertaken with the assistance of 11 ministries with an interest in water and land resources. The project has uploaded over 13,000 items on to Claromentis so that these are available as a shared resource for the planning team. The data has been divided in to three sets: facts, needs, and opportunities. Opportunities represent possible interventions, potential calls on the national budget in the near and longer term that need to be prioritised for the water and agriculture sectors as a whole. Organising and checking this volume of data is an ongoing process leading to the formation of databases of essential information for planning.

As a first stage all data provided by the ministries has been uploaded to Claromentis so that it acts as a repository for original documents (most are scanned). Given the many uncertainties about the future it has seemed important to place as much original material as practicable in a secure environment which offers the possibility of easy access. The next stage involves review of the data, quality control, and recommendations to improve data quality or fill gaps – this process has progressed faster for some data sets than for others. Generally the hydrological data sets have progressed furthest with the agricultural data review the least developed. As the MoWR staff on the study visits learnt, work on model development soon highlights gaps and inconsistencies in the data.



Not unexpectedly, there are significant gaps in some data sets. Some information that would be expected is missing; other information is incomplete, for example inadequate geo-referencing. Considerable effort was made to seek out such data through the assistance of the nominated officials in the ministries. There nevertheless remains further information to be collected as the planning process progresses.

To help provide for future data needs a program of support to MoWR for hydrometric monitoring was initiated. Specialists from the USGS and

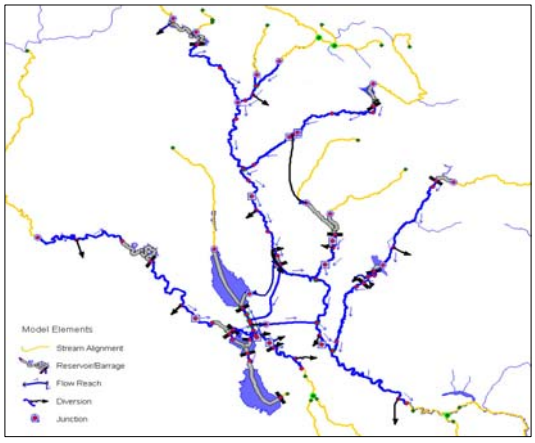
USACE assisted with the procurement of new equipment and provided field and office based training to introduce the new technologies of ADCP flow gauging and satellite telemetry water level recorders. The first results were accessible on the USGS website from April 2006.

Development of Tools for Planning

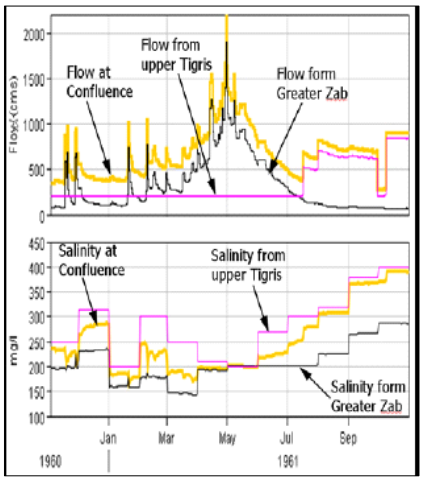
Iraq's highly developed system of reservoirs, barrages, and irrigation facilities offer many possibilities for managing the nation's water resources, while ongoing upstream development in Turkey, Syria and Iran introduces significant uncertainty into any comprehensive planning analysis. Modelling studies of water volumes and quality have therefore been key components of the Phase 1 program. However, the development of other models and analytical tools to support the overall strategic planning process has also been an important activity. A number of these planning tools are described to illustrate the development work and the place of the tool in the 'toolkit', starting with the water management models.

Water System Management Model

The Tigris-Euphrates water management system model (WMSM) contains a configuration of the physical layout of all projects and control points that have a bearing on the formulation of the MoWR regulation plan. The WMSM was built using the ResSim software by HEC in collaboration with staff from MoWR for an earlier project, the Iraqi Marshland Restoration Program, and has been undergoing continuing development under SWLRI. The WMSM performs scenario-based alternatives analysis using rule-based, multi-purpose, seasonal operation criteria, combined with hydrologic routing in the complex network of interconnected reservoirs, river reaches and control points on the Tigris-Euphrates within Iraq.



In parallel with the WMSM development the consultants, again in collaboration with MoWR, have worked to improve on the vital trans-boundary inflow data sets that will drive the planning scenarios within Iraq. This important work has been reported in detail so that Iraqi planners are properly aware of the many assumptions that have had to be made and the reliability of these data sets.



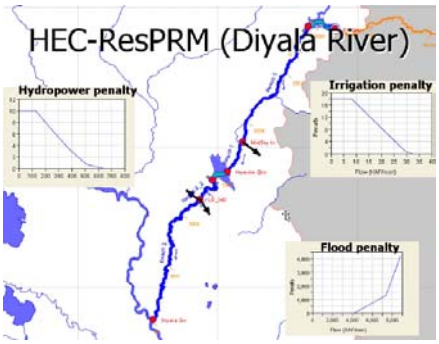
In addition to the quantity of water available for various needs in Iraq, the quality of the water plays a huge role in determining water management strategies. Salinity concerns dominate many aspects of planning for irrigation, water treatment or environmental restoration in Iraq. Under SWLRI, additional capability was added to the WMSM to determine salinity concentrations at each significant location, so that this water quality information is computed directly as part of the water management simulations. Having this facility in the model has pointed up the need for MoWR to review its water quality monitoring activities to provide more targeted data in the future.

As part of the WMSM water quality development the consultants

set up a 1-D hydrodynamic model, HYDRO-1D, to compute water quality in the major reservoirs and to establish salinity coefficients for the ResSim Tigris-Euphrates model. The testing was hampered by data limitations but preliminary coefficients were derived and the two test beds: Tharthar reservoir and the Tigris reach through Baghdad, have been handed over to MoWR and can be rerun when more data is available.

Pilot Reservoir System Optimisation

At the request of MoWR, SLWRI also initiated a completely new model, using the HEC Reservoir Optimization (ResPRM) modeling software for multi-purpose, multi-reservoir systems. This allows a different type of analysis than alternative-based simulation modelling. The ResPRM applies criteria, often economic-based, in the form of penalty functions to optimize reservoir system performance. The pilot ResPRM model focuses on the Diyala River Basin, which features two reservoirs, three major irrigation diversions, and operates for irrigation, hydropower, and flood control objectives.



The use of ResPRM within the MoWR serves as an important demonstration of the link between alternatives for water usage and the economic costs and benefits, the economic consequences of development options being a major concern in the strategic planning process.

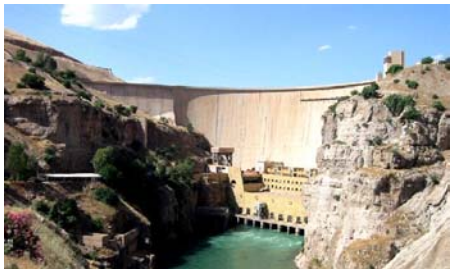
Pilot for Localised Water Quality Modelling

Resource planners also have to deal with localised pollution problems, such as the spread downstream of pollution from large sewage works or industrial sources. The HYDRO-1D software tools described above can be used to model this type of situation. In order to demonstrate such an application requires adequate water quality sampling data for parameters relevant to the pollution problem.

To date the model has only been tested for salinity (as part of the ResSim development), but any of the following parameters can be modelled if the data is available: biological oxygen demand, dissolved oxygen and any conservative determinand or non-conservative determinand with a known degradation rate.

Multi-criterion Decision Model for Iraq

Multi-criterion analysis (MCA) is aimed at helping decision-makers faced with several objectives which sometimes conflict with each other and to make the decision making process more transparent to stakeholders.

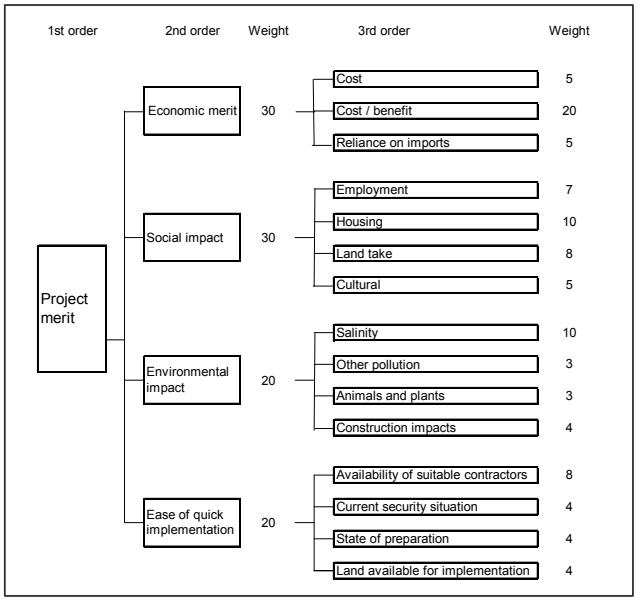


To set up a model (a MCDM) it is necessary to define a set of criteria and to assign a relative importance weight to each one. The model also needs a value function or scoring rule for each criterion.

The model operates on a set or long-list of alternatives, each of which is assigned a score under each criterion. Once these

elements are in place (the set of criteria, their weights and scoring rules, and the list of alternatives), the model works by computing an overall merit index value for each alternative.

When the merit index values have been computed, the alternatives can, if desired, be ranked and sorted to give a priority list, those with high index values at the top of the list. This prioritised list can then be used to draw up investment programmes to match annual budgets or other constraints.



To be appropriate to Iraq the MCDM needed to be developed in an iterative manner, trying out early versions with real alternatives, before it gave a good representation of the decision-makers' preferences and value judgements. The Iraq MCDM was developed with MoWR staff during a Study Visit.

The Guidance Note on Multi-criterion Analysis was prepared with their active participation. Subsequently they have carried on testing the MCDM on further projects and reported on their results to the Steering Committee.

These staff have also arranged to give a course of instruction on the MCDM to colleagues so that the number of people familiar with the technique is already expanding.

Other Tools

The toolkit contains a range of items:

- Some sector specific (eg hydropower, municipal water supply)
- Some relevant to particular fields (eg hydrogeology, water chemistry and pollution, environment, economics), and
- Others of more general application (eg GIS and mapping tools).

Some such as Excel workbooks for calculating irrigation requirements are there to aid in the preparation of data for use with the Tigris-Euphrates WMSM or other models.

Many of the tools have associated guidance notes and some, like HYDRO-1D, also have user manuals.

At the start of the SWLRI project in July 2005 GIS capacity was limited to a few small centres, the largest of which was the GIS Section within the MoWR. From the start the SWLRI team have emphasised the value of using maps and GIS tools to assist in strategic planning work. In February 2006 the first GIS Cluster meeting was held with representatives of 11 ministries in Erbil to raise awareness of the potential of GIS tools and to start a collaborative process by which all ministries contributing to SWLRI Phase 1 would develop their GIS capability and move towards adoption of common standards to facilitate future exchange of data.

A strategy for developing and maintaining a suite of GIS tools and map products for use by the SWLRI Unit, and for establishing formal mechanisms for sharing expertise and exchanging data, is under preparation in collaboration with MoWR and the other ministries.

Demonstration of the Planning Process

Two study visits were key to the process of demonstrating both the planning processes being suggested and also the operation of some of the planning tools being developed for the use of the SWLRI Unit. Focused seminars covered subjects such as multi-criterion analysis (MCA), project cycle planning for international funding, and stakeholder participation, and case studies were used to illustrate the complete process of master planning.

Prioritising Opportunities

In terms of starting to develop preliminary intervention packages the approach was to demonstrate the multi-criterion analysis process on a range of typical interventions in the irrigation sector using information from the Ministry of Water Resources web site.

	MULTI-CRITERION INDEX					RANKING
	GROUP CONTRIBUTION					
project	Economic	Social	environm-ental	impleme-tation	*OVER ALL MERIT INDEX*	
	max 30	max 30	max 20	max 20	100	
Bakhma Dam cns./514.5 m$	19.3	8.1	10	15.6	53	6
Hemreen Dam rehi./1.776m$	8.1	17	12.1	15.6	52.8	7
Canal Cleaning equi.133.0m$	13.25	14.64	12.57	11	51.46	8
Const.of 40 Kehreezs/1.m$	25	14.92	8.8	14.4	63.12	3
Babilo riverl lining/.883 m$	14	17.25	13.2	19.65	64.1	2
Hor Rejab reclamaition/5.250 m$	12.5	19.15	12.7	15.6	59.95	4
Nahar Saad reclaim./17.639m$	12.5	20.75	13.7	18.8	65.75	1
Razzaza P.S./4.526m$	4.5	17.25	12.9	13.2	47.85	9
G arraf Cross Reg. rehib.1.101m$	5	17.25	14.1	15	46.35	10
Al-Shinafia Drain Excavation/100	13	17.25	12.75	16.2	59.2	5

Assessing Future Needs

Tools were developed to assist planners assessing future needs. These included, for example, the following.

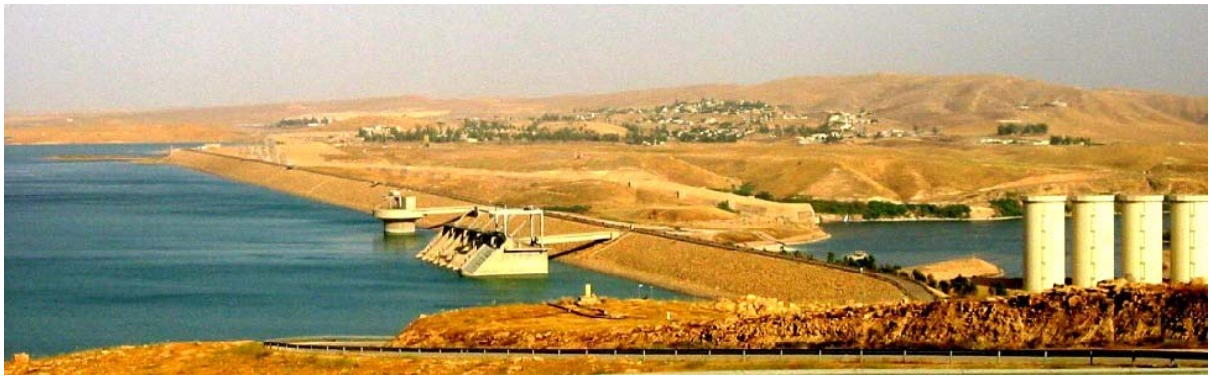
For municipal and rural water supplies a simple procedure for forecasting demand has been written up as a Guidance Note and preliminary overall estimates of water demand throughout Iraq to 2025 have been derived. These must be regarded as indicative projections that will need to be updated in the future.

Governorate	Average Water Demand (m3/d)					
	2010			2020		
	Urban	Rural	Total	Urban	Rural	Total
Nineveh	497,449	208,882	706,331	668,530	280,719	949,249
Al-Tameem	189,479	54,669	244,149	254,644	73,471	328,115
Diala	188,238	174,011	362,249	252,976	233,856	486,832
Al-Anbar	220,195	134,099	354,294	295,924	180,218	476,142
Baghdad	2,197,611	168,684	2,366,296	2,953,406	226,698	3,180,104
Babylon	224,915	165,651	390,566	302,268	222,621	524,888
Kerbela	163,485	57,641	221,125	219,710	77,464	297,174
Wasit	162,468	97,023	259,491	218,343	130,390	348,734
Salah Al-Deen	161,702	128,649	290,351	217,314	172,893	390,207
Al-Najaf	215,203	63,757	278,960	289,216	85,684	374,899
Al-Qadisiya	151,826	91,504	243,330	204,042	122,974	327,016
Al-Muthanna	78,284	65,031	143,315	105,207	87,396	192,603
Thi-Qar	273,772	128,967	402,739	367,926	173,321	541,247
Maysan	158,632	55,754	214,386	213,188	74,928	288,116
Basrah	451,225	80,381	531,606	606,409	108,025	714,434
Duhouk	110,822	26,191	137,013	148,935	35,199	184,134
Arbil	338,948	69,126	408,075	455,518	92,900	548,418
Sulaimaniya	385,872	106,178	492,050	518,580	142,694	661,274
Total	6,170,128	1,876,197	8,046,325	8,292,136	2,521,452	10,813,588

Data from the Ministry of Energy has been used to develop a workbook that gives an indication of some of the possible scenarios for hydropower development in Iraq from now until 2030.

Period	Additional Power Demand (MW)	% of Total Power Demand which could be met by Hydropower	Additional Hydropower Power Demand (MW)	Potential Schemes	Power (MW)
2005 - 2010	3,061	20%	**612**	Bekhme	1,500
2010 - 2015	4,293	18%	**773**	Samarra-1	56
				Samarra-2	300
				Nineveh-1	300
				Nineveh-2	20
				Rawa	330
				Qaiyara	420
				Qaiyara Diversion	400
2015 - 2020	6,021	16%	**963**	Makhul	500
				Al-Baghdadi	400
				Assur	415
				Assur Diversion	400
				Altun Kupri	300
				Kili	80

Period	Additional Power Demand (MW)	% of Total Power Demand which could be met by Hydropower	Additional Hydropower Power Demand (MW)	Potential Schemes	Power (MW)
2020 - 202	8,444	14%	**1,182**	Abassi	200
				Tikrit	600
				Tikrit-1	300
				Tikrit-2	280
				Daur	170
				Badush-1	154
				Badush-2	38
				Khamam	240
				Nimrud	80
				Safiya	170
				Quwair- 1	85
				Quwair- 2	85
				Taq-taq	400
2025 - 203	11,843	12%	**1,421**	Qala-Diza-1	300
				Qala-Diza-2	165
				Quwair- 3	110
				Amadiya	900
				Rashawa	550
				Bawn	220
				Mandawa	480
				Halwan	200
				Taili with Murak H	300
				Tongar	155
				Qara Teppe	245
				Qara Teppe-2	140



Training and Capacity Building

Capacity building included a number of training courses and two study visits:

Course Subject	Nr of courses and location	Attendees
Claromentis user training	2 (Erbil)	All participating ministries
Claromentis Administrator	1	MoWR
Introduction to GIS	2 (Erbil)	All participating ministries
GIS for asset management	1 (Basra)	All participating ministries
GIS and remote sensing advanced users	1 (Basra)	All participating ministries
Gauging station upgrade and use of ADCP for flow measurement	1 (Dohuk)	MoWR, Kurdish Regional Ministry of Water
6-week study visit	1 (Cambridge, UK)	MoWR
1-week study visit	1 (Cambridge, UK)	MoWR

In addition to the formal courses listed above, Phase 1 included some 8 data collection meetings and two GIS cluster meetings. These were attended by delegates from all participating ministries and have encouraged networking among professionals in the water sector.

The 6-week study visit focussed on data quality control and capacity building on aspects of the planning process. The Iraq MCDM was developed during this period and it was very pleasing to see that the MoWR staff were already introducing colleagues to the techniques. This concept of training trainers is one area that should be given more attention in Phase 2.

The 1-week study visit focussed on transboundary water management looking at practical experience from other river basins, and in particular at the implications of the European Water Framework Directive that might come to apply to the Tigris-Euphrates basin if Turkey continues a path towards eventual membership of the EU.

Phase 2 Scope of Work

The consultants, the Steering Committee and the SWLRI Unit held a preliminary workshop on the nature and scope of Phase 2 in July 2006.

The consultants have taken these ideas and drafted a Phase 2 Scope of Work document. The document has been prepared in the knowledge that it should be a proposal that the MoWR could take forward into discussions with potential donors.

The proposals cover further strengthening of the fundamental building blocks for a successful strategy development process: data issues, modelling enhancements, more capacity building, greater collaboration between ministries and the inclusion of other stakeholders.

A government review of legal and institutional arrangements has also been identified as an essential precursor to achieving a fully-fledged planning organisation for the water sector.

Phase 1 Completion Report

The Phase 1 Completion Report consists of a four-volumed document, comprising the main report and supporting annexes. This documentation makes use of, and includes considerable reference to the analytic tools which have been developed, or have been incorporated into the "toolkit".

The report's contents are as follows.

Volume 1	Executive Summary	
Volume 1	Main Report	
Volume 2	Phase 2 Work Plan	
Volume 3	Annex 1	Review of Phase 1 Data Sets
Volume 3	Annex 2	*Guidance Note 02*: Geographic Information Systems and Databases - Strategy for Developing Planning Tools
Volume 3	Annex 3	*Guidance Note 05*: Opportunities – Data Requirements
Volume 3	Annex 4	*Guidance Note 04*: Managing Water Resources in Iraq – The Planning Process
Volume 3	Annex 5	*Guidance Note 01*: Multi-criterion Decision Analysis and Models – Introductory Explanation
Volume 3	Annex 6	*Guidance Note 09*: Introduction to Cost-Benefit Analysis
Volume 3	Annex 7	*Technical Note 05*: Possible Water Allocation Model
Volume 3	Annex 8	*Guidance Note 10*: Preparing Farm Budgets
Volume 3	Annex 9	*Guidance Note 03*: Irrigation Water Requirements
Volume 3	Annex 10	*Technical Report 06*: Groundwater
Volume 3	Annex 11	*Technical Report 03*: Hydraulic and Water Quality Modelling
Volume 3	Annex 12	*Technical Report 04*: Municipal Water Supplies
Volume 3	Annex 13	*Guidance Note 06*: Forecasting Demand for Municipal and Rural Water Supplies and Wastewater Services
Volume 3	Annex 14	*Guidance Note 07*: Demand Management for Municipal Supplies
Volume 3	Annex 15	*Guidance Note 08*: Hydropower Spreadsheet
Volume 4	Annex 16	*Technical Report 01:* Stream Gage Network Renovation
Volume 4	Annex 17	*Technical Report 02*: Development of the Tigris-Euphrates Water Management System Model
Volume 4	Annex 18	*Technical Report 03*: Pilot Trial of ResPRM on Diyala Basin

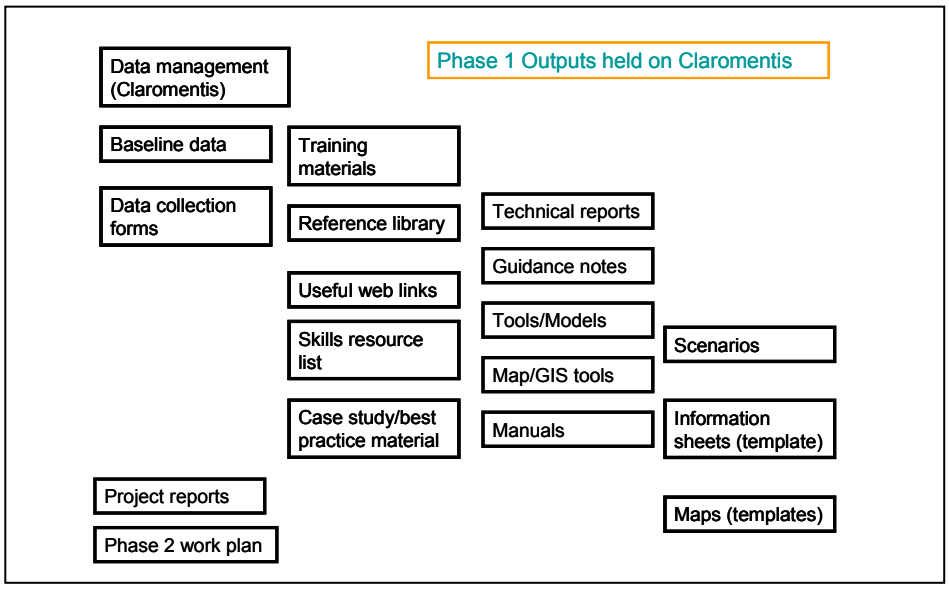
These technical reports and guidance notes prepared during Phase 1 are accompanied by a number of associated models and analytical tools. Both the documents and the models are held together on the Claromentis system, providing a considerable one-stop resource.

Summary of Phase 1 Outputs

In addition to the contents of the SWLRI toolkit and the Phase 1 Completion Report referred to above, Phase 1 has seen the issue of training and study visit reports, a data management report, the Inception

and Interim project reports, minutes of Steering Committee meetings, GIS Cluster meetings, and data collection meetings.

The Claromentis system hardware and software has been handed over to MoWR. This includes the data repository and the toolkit, together with the project reports, and minutes and presentations associated with project meetings.



AGRICULTURE RECONSTRUCTION AND DEVELOPMENT PROGRAM FOR IRAQ

STRATEGY FOR WATER AND LAND RESOURCES IN IRAQ
Phase 1 Project Completion Report
Main Report

October 2006

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STRATEGY FOR WATER AND LAND RESOURCES IN IRAQ
Phase 1 Project Completion Report

Main Report

List of Contents

Page

Preface

The Strategy for Water and Land Resources in Iraq (SWLRI) was initiated at the request of the Ministry of Water Resources (MoWR) in May 2005.

The Phase 1 project was launched in July 2005 and was scheduled for completion in September 2006.

In mid-August 2006 the project was put 'on hold' while a review of financing was carried out on the overall Agricultural Reconstruction and Development Program in Iraq of which SWLRI was a component. Following the financing review the SWLRI Phase 1 project was curtailed. As a result the present Phase 1 Completion Report is a preliminary draft, incomplete in many respects, that reflects the stage that the team had reached in documenting the conclusions of their work at the time when the project was put on hold.

1 Introduction

1.1 Background to the Project

A planning document was prepared between 1972 and 1982, by the Iraq Ministry of Irrigation and the USSR institution Selkhozpromexport. It covered water, salt and soil management, agriculture and irrigation, fisheries, water supply, hydropower, flood control, erosion control, and navigation. Thorough data collection, mathematical modelling, and evaluation of various scenarios led to a detailed proposal for action over the twenty-year period to 2000 called the 'General Scheme Second Stage', and this has guided much of the country's policies and actions since the early 1980s.

The planning horizon covered by the general scheme second stage has passed, and with significantly changed external circumstances, Iraq's Ministry of Water Resources (MoWR) recognised that a new effort was needed to develop an updated integrated strategy plan for developing and managing its water resources. In 2003 MoWR requested the US Army Corps of Engineers (USACE) to prepare a concept proposal. The resulting document 'Strategic vision for management of Iraq's water resources – a concept proposal' proposed a two-phase approach to the task, with Phase 1 lasting up to 18 months and Phase 2 taking four or five years.

The concept was further developed early in 2005 culminating in a scope of work discussed with the MoWR and other Iraqi ministries at a workshop in Amman from 7-9 June 2005. It was agreed that Phase 1 would be completed in 14 months and would be led mainly by Consultants with extensive MoWR oversight and involvement, while Phase 2 would be led mainly by MoWR. The Phase 1 strategic planning effort is being undertaken as a component to the ongoing USAID funded Agricultural Reconstruction and Development Program for Iraq (ARDI) Project.

The Phase 1 project was launched in July 2005 and was scheduled for completion in September 2006.

1.2 Phase 1 Objectives

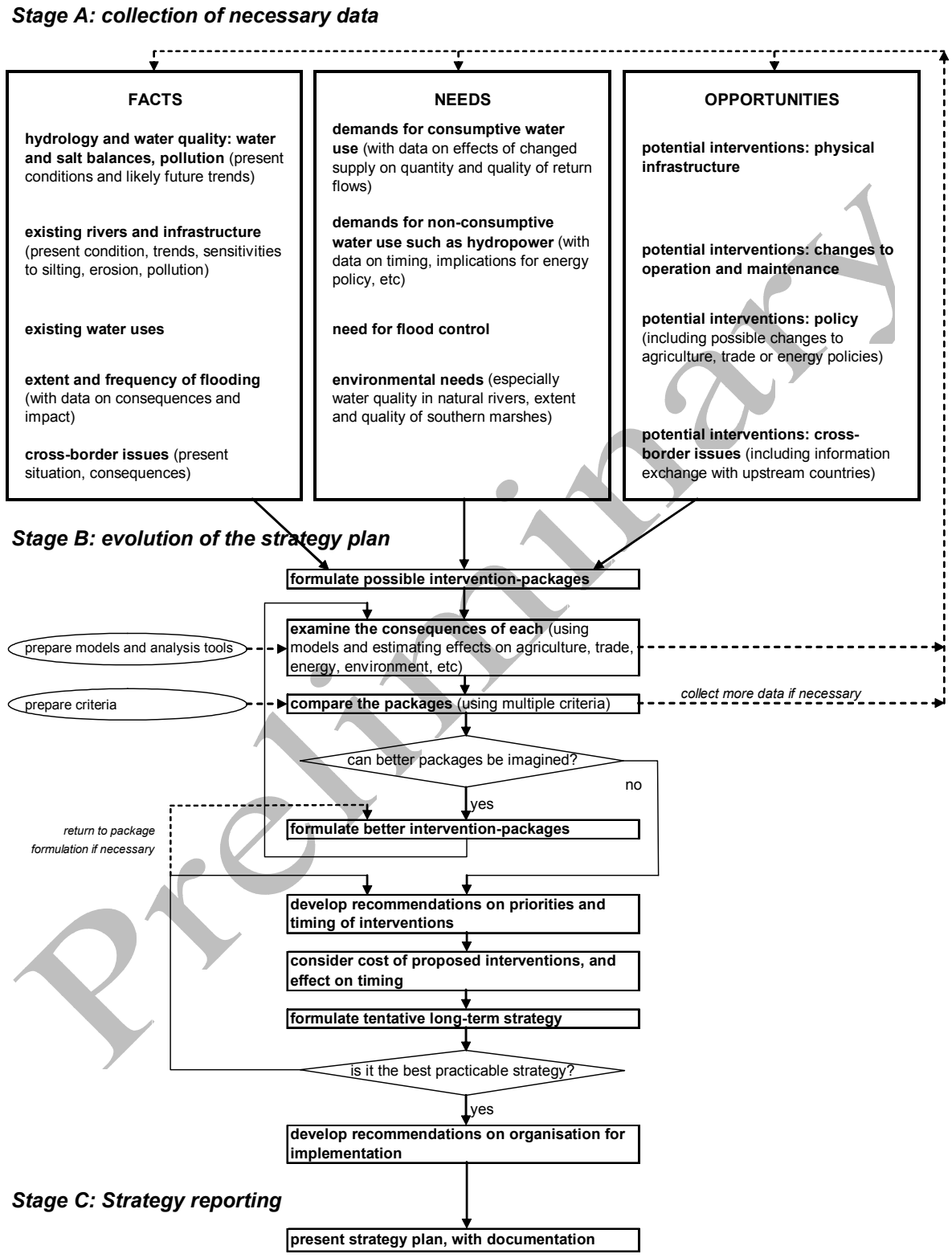
The overall long term objective of the strategic planning effort is to provide a sound and comprehensive basis for Iraq's management and development of its water and land resources over the next few decades, together with a framework and methodology for ongoing updating of plans.

Figure 1.1 presents a diagrammatic representation of the proposed overall approach to the development of the Strategy for Water and Land Resources in Iraq, both in Phase 1 and thereafter.

The intention has been to support Ministry of Water Resources (MoWR) as the agency with primary responsibility for water and land resources planning. In Phase 1 this included assisting with the establishment of a new unit at the ministry's Sader Al Qanat complex, delivering data sets, handing over models and other tools, and providing capacity building in modern techniques for planning.

Phase 1 has focused on Stage A and made a start on Stage B (Figure 1.1), particularly the preparation of models and other tools. By providing worked examples of the processes illustrated in Figure 1.1 the consultants have worked with MoWR staff to build their capacity to take the process forward – and to develop the national strategy in later phases.

Figure 1.1: SWLRI Planning Approach



1.3 Phase 1 Activities and Outputs

The Phase 1 Scope of Work listed the planning work to be completed in Phase 1:

1. collect all available relevant data, making use of recent and current work by others;

2. organise the data into the three data sets (facts, needs and opportunities), with systematic arrangements for accessing the information and for its periodic updating and extension in the future;

3. add to the third data set any further opportunities that are perceived in the course of this work;

4. prepare the criteria for comparison of interventions and packages, discussing the criteria widely by means of early drafts circulated for discussion to several stakeholders;

5. collect or prepare the necessary models and analysis tools for examining the consequences of possible intervention-packages, adapting these tools to the expected comparison criteria (some models are already available, thanks to current or recent work by others);

6. carry out the first round of package formulation and comparison, at least in a preliminary manner, using this activity to test, refine and improve the models, tools and criteria;

7. formulate recommendations, scope of work and budget for Phase 2, possibly including the specification of studies and investigations needed to enhance the data sets to serve the ongoing planning process;

8. describe the results of all the above activities in a Phase 1 Completion Report.

In addition to these sequential activities (1) to (8) described above, the schedule shows two further activities:

- capacity-building and institutional strengthening for the staff of MoWR, its regional counterparts, and other Iraqi ministries and institutions, to be achieved as far as practicable by involving them in the Phase 1 work;
- progress reporting in advance of the Phase 1 completion report, in the form of two brief reports during the course of the work: an Inception Report and an Interim Report: to keep MoWR and other stakeholders informed of progress and interim findings.

Table 1.1: Where to Find Activities in the Phase 1 Completion Report

Nr	Activity	Location in Phase 1 Completion Report[1]
1	Collect all relevant data	Chapter 3 and Annex 1
2	Organise the data	Chapters 3 and 4 and Annex 1
3	Opportunities data	Annexes 1 and 3
4	Prepare criteria for comparison of interventions	Chapter 4 and Annex 7
5	Collect or prepare models and analysis tools	Chapter 4 and Annexes 2,5,7,8,9,11,12,13,14,15,17,18
6	Preliminary package formulation and comparison to test, refine and improve models, tools and criteria	Chapter 5 and Annexes 12 – 15, 17-18
7	Formulate Phase 2 scope of work	Chapter 7 and Volume 2
8	Phase1 Completion Report	-
	Capacity building and institutional strengthening	Chapter 6
	Progress reporting	-

Notes: [1] See Table 1.2 for a detailed list of annexes.

The technical reports and guidance notes prepared during Phase 1 (the annexes to the Phase 1 Completion Report) are accompanied by a number of associated models and analytical tools. Both the documents and the models are held together on the Claromentis system.

1.4 Structure of the Report

The completion report comprises this document and a number of annexes bound as separate volumes.

Table 1.2: Report Structure

Volume 1	Executive Summary	
Volume 1	Main Report	
Volume 2	Phase 2 Work Plan	
Volume 3	Annex 1	Review of Phase 1 Data Sets
Volume 3	Annex 2	*Guidance Note 02*: Geographic Information Systems and Databases - Strategy for Developing Planning Tools
Volume 3	Annex 3	*Guidance Note 05*: Opportunities – Data Requirements
Volume 3	Annex 4	*Guidance Note 04*: Managing Water Resources in Iraq – The Planning Process
Volume 3	Annex 5	*Guidance Note 01*: Multi-criterion Decision Analysis and Models – Introductory Explanation
Volume 3	Annex 6	*Guidance Note 09*: Introduction to Cost-Benefit Analysis
Volume 3	Annex 7	*Technical Note 05*: Possible Water Allocation Model
Volume 3	Annex 8	*Guidance Note 10*: Preparing Farm Budgets
Volume 3	Annex 9	*Guidance Note 03*: Irrigation Water Requirements
Volume 3	Annex 10	*Technical Report 06*: Groundwater
Volume 3	Annex 11	*Technical Report 03*: Hydraulic and Water Quality Modelling
Volume 3	Annex 12	*Technical Report 04*: Municipal Water Supplies
Volume 3	Annex 13	*Guidance Note 06*: Forecasting Demand for Municipal and Rural Water Supplies and Wastewater Services
Volume 3	Annex 14	*Guidance Note 07*: Demand Management for Municipal Supplies
Volume 3	Annex 15	*Guidance Note 08*: Hydropower Spreadsheet
Volume 4	Annex 16	*Technical Report 01:* Stream Gage Network Renovation
Volume 4	Annex 17	*Technical Report 02*: Development of the Tigris-Euphrates Water Management System Model
Volume 4	Annex 18	*Technical Report 03*: Pilot Trial of ResPRM on Diyala Basin

2 Approach to Strategic Planning

2.1 Introduction

The overall long term objective of the strategic planning effort is to provide a sound and comprehensive basis for Iraq's management and development of its water and land resources over the next few decades, together with a framework and methodology for ongoing updating of plans.

Successful planning entails:

- A vision of the intended outcome
- Evaluation of complex situations
- Recognising resource limitations and addressing these
- Attention to detail.

The following sections set the scene and are supported by a number of annexes providing guidance on processes.

2.2 Setting and Implementing a Strategy

A strategy is usually taken to be the top level in the planning process, where broad targets are established. This requires setting out general concepts and defining generic approaches to address the targets.

A potential danger in developing a strategy is to over-define the targets and especially to define too narrowly the means of achievement or implementation. The consequences of this are:

- It becomes difficult to respond to changing circumstances. Possibly a strategy is set with a time horizon of ten or fifteen years, sometimes more. If external factors make the strategy inappropriate, the choices are:
  - To continue as though these factors did not exist. This may seem necessary for political or institutional reasons, but it does not make good planning. There is a considerable risk that resources will be expended wastefully.
  - To re-write or modify the strategy. The consequence of this is that people loose faith in the planning process and rather than a strategy being seen as a strong guiding tool, it is viewed as a quick fix and is not robust.
- Opportunities for taking advantage of new approaches are missed. These may be technical, organisational or institutional in nature.

A good strategy can be encapsulated in a few pages. It needs three elements:

- A statement of what is to be achieved, namely:
  - The overall targets which the strategy aims to meet

  - Broad details of the preferred or intended method of implementation. This is to provide clarity for lower-level planning tools and also to provide a basis for commitments on resourcing.

- Commitment of appropriate resourcing. In this sense, resourcing covers all components necessary to implement the strategy. Thus, as well as the more obvious elements of staff and financing, it includes legislation (and changes to this), institutional facilities (such as granting of permits), fiscal measures if appropriate, etc. The details, however, do not generally belong in the strategy and indeed may be so complex, and variable with time, that it is impossible to describe them accurately in a short, focused strategy document.

- A statement providing the context in which the strategy was developed and establishing the main premises on which it is based. It will then be clear should these factors change, that the strategy itself will need to be revisited. The statement should also include a view on what is envisaged after the period for which the strategy has been developed. This must not be a prescriptive statement but is used to reinforce the statement on context.

The two main tools for implementing a strategy are:

- An action plan, containing a series of sub-plans each focused on specific elements for implementing the strategy. Some of these may be focused on the short term, others medium to long term.

- A complementary financing plan.

2.3 Planning Tools

2.3.1 Introduction

Considerable guidance has been developed by both national institutions and international bodies (such as the Food and Agriculture Organisation of the United Nations) to aid those engaged in planning activities. These are set at different levels of complexity and range from high-level planning to activities associated with detailed planning of project implementation.

The available guidance covers the various assessment tools and their application. There are three forms of tool widely employed, namely:

- Impact assessments

- Multi-criteria analysis

- Economic analysis.

These are complementary tools. All are regularly used together in examining potential interventions.

2.3.2 Impact Assessments

Impact assessments are directed at informing decision makers of the consequences of a proposed intervention.

Environmental and social impact assessments are widely employed; health impact assessments are undertaken more regularly than in earlier years. (This entails investigating the consequences of an intervention on the health of those directly engaged on the intervention and those who may be affected incidentally.)

Regulatory impact assessments are used to assess the impact of a proposed regulation or legislation (or changes to existing instruments) on all elements which might be affected. This includes environmental and social impacts, but will also include impacts on socio-economic aspects, national interests and obligations in international affairs, and similar matters.

In many countries there are national guidelines established for the form and content of impact assessments. International financing agencies often require impact assessments for projects they finance and may prescribe what the assessment must cover.

Impact assessments are useful for identifying issues which:

- Potentially could lead to late changes in project design, or even project abandonment
- Require addressing in project design. The design may seek to minimise or avoid adverse aspects. It may include monitoring – the impact assessment may identify baseline monitoring which will provide considerable insight into project impacts.
- Provide the opportunity for obtaining additional benefits from project interventions.

2.3.3 Multi-criterion Analysis

Multi-criterion analysis (MCA) is aimed at helping decision-makers faced with several objectives which sometimes conflict with each other.

It is a powerful tool for assimilating complex issues and determining a suitable outcome which is understandable to specialists from different disciplines as well as the public. This is because it treats systematically and uniformly issues with technical, social, political, environmental, economic and other bases. Consequently MCA allows judgements to be reached on the merits of interventions which have diverse components and impacts. Importantly, MCA allows for the judgements to be weighted in accordance with the significance of the impacts. The significance should determined at a societal level, and hence be broadly acceptable within political and ministerial circuits.

However, the process of weighting the criteria is also a potential weakness. It is imperative that weightings are set objectively and are broadly accepted. Furthermore, it is critical that weightings are not adjusted between assessments of interventions as this could result in manipulation of the result.

MCA is described in detail in Annex 5.

2.3.4 Economic Analysis

Because finance looms so large in decision making concerning interventions, economic analysis can be afforded considerable weight. Whilst this is appropriate, it is only so if the analysis is properly formulated.

This can only be achieved if the interventions and benefits under the project are adequately and comprehensively identified. Whilst the precision of this will vary according to the stage in project conceptualisation / development, a rigorous, systematic approach is required to avoid gross omissions, particularly understatements of cost or overstatement of benefits.

Cost-benefit analysis (CBA) is the principle tool used to judge anticipated economic performance. This takes several forms, the most common of which are:

- **Net present value** (NPV). For technically mutually exclusive actions, the aim is to maximise NPV rather than make choice on other indicators
- **Benefit / cost ratio** which is used to rank projects in diminishing economic attractiveness.
- **Internal rate of return** which allows direct compression with a "norm" threshold, which is independent of project size.

All forms of economic analysis require realistically identifying the costs, and taking account of whether these include intra-government payments (such as taxes) or are distorted by national policies covering imports, exports and various forms of subsidies.

Identification of benefits can be problematic. Project sponsors can be over-optimistic, for example, so artificially raising the likelihood of the project appearing attractive for investment. In some cases, monetarising the benefits requires considerable assumptions as there are no traded prices to use as a basis. Thus the valuation is open to manipulation. However, unlike with MCA, the process is not transparent and hence results may be misleading.

An introduction to cost-benefit analysis given in Annex 6.

2.4 Monitoring and Evaluation

Monitoring and evaluation is an integral component of the strategic planning process as it informs planning decisions based on rigorous analysis of the outcome of earlier decisions. This allows capitalising on past successes and avoiding undertaking interventions in a way which, experience suggests, risks failure.

Monitoring and evaluation has to be built into all phases of project implementation. Unless this is included in high level planning there is a risk it will not be undertaken, or the results will not be disseminated widely.

It is important to consider all monitoring and evaluation in a positive light. Inevitably on any intervention there will be elements which are more successful than others are; in some cases an aspect may go seriously wrong. The ensuing loss is compounded if the opportunity to learn from the experience and avoid repetition is missed.

Monitoring and evaluation should also be used to understand actual progress against strategic objectives and the action plans. By identifying when actual performance deviates from the plan, it is possible to identify what steps should be taken to rectify this, to keep progress aligned with the strategy. Understanding the impact of the changing external environment as it occurs allows approaches to be adjusted to ensure that targets are achieved or adjusted appropriately.

3 Data Compilation

3.1 Introduction

Data collection and review has been one of the major activities in Phase 1. The present chapter briefly recapitulates the approach to this important activity and then describes the status of data collection, identifies outstanding data, and discusses the quality of the information received. More detailed assessments are contained in Annex 1.

Regular consultation between MoWR and ARDI has been crucial in keeping the focus of attention on data collection. The ARDI local team have made frequent visits to participating ministries to support the data compilation exercise, including spending time in Baghdad, Erbil, and Sulymaniyah.

The project Steering Committee has also kept a close eye on the progress of the data collection and this high level support has been valuable in promoting cooperation between ministries in the data collection effort.

3.2 Identifying What Data is Needed for Planning Studies

There are several types of information that need to be compiled to provide the basis for strategic planning of water and land resources:

1. **Inventories** which list and map the location of physical infrastructure (dams, boreholes, canals, drains, pumping stations etc), and monitoring points. The inventories should be 'live' and reflect the number and status of facilities in the country as they are now, and in some cases as they were in the past.

2. **Time series records** of river, canal and drain flows, water quality, population details, agricultural production statistics etc. These should be regularly updated at a frequency to suit the type of data.

3. **Areal features** of the natural environment and anthropogenic activities (soil type, forestry, land classification, population distribution, cropping patterns, urban areas, seasonal flooding, salinisation, etc). When linked to remote sensing and to GIS areal information can be obtained and presented in many ways that contribute to the strategic planning process.

4. The **planning framework**. Details of national aspirations as expressed in government policies and legislation that provide the context for strategic planning for the water and agriculture sectors. Included in this are the policies and plans for other sectors (energy, health, trade etc) that are linked directly or indirectly to the water and agriculture sectors. The water sector cannot be considered in isolation and up to date information on the activities in other sectors will be needed.

5. **External pressures**: economic status and relations, migration, international relations, climate change, international commodity prices, etc.

The following sections discuss the requirements in relation to the three data sets referred to in Figure 1.1: facts, needs, and opportunities.

3.2.1 The 'Facts' Data Sets

All the data types and examples listed above are associated with the 'facts' data. The General Scheme reports provided guidance as to what should be collected in order to support the planning process. The consultants prepared a preliminary list of the required data to describe the baseline situation in terms of natural and man made elements. This list is reproduced in Annex 1. In addition ministries were asked to update various tables from the General Scheme – this particularly applied to agricultural data. Throughout the need for geo-referenced data was emphasised so that the maximum use could be made of GIS and mapping tools.

3.2.2 Data on Needs

Needs data is more likely to be synthesised than measured so that compilation of this data set is more a matter of analysis of other data than the collection of actual records.

Consumptive water uses (for agriculture, industry, or potable water) are not generally monitored with sufficient frequency or accuracy to make the data very practical for planning studies. In particular, records where available are usually for bulk abstraction and can be very difficult or impossible to disaggregate. Therefore the needs data is typically built up using standard procedures and aggregated to give the estimated bulk demand. This process calls for other data from the 'facts' category. For example in order to estimate irrigation water requirements for a whole scheme it is necessary to know what crops are being or are to be grown and over what area, the planting and harvesting dates, design meteorological conditions, land preparation requirements, and irrigation efficiency allowances etc. If the estimate is for a future planning horizon then the cropping pattern, the land preparation requirements and the irrigation efficiency could all be different depending on government policies, and projected changes in the socio-economic situation.

3.2.3 Information on Opportunities

Opportunities represent possible actions or interventions for MoWR and other ministries to budget and programme for, and to implement in the short, medium or long term horizons. They represent potential calls on the national budget in the near and longer term and as such need to be prioritised for the water and agriculture sectors as a whole. Opportunities cover an exceedingly wide range of possibilities from new studies to actual construction, from policy change to capacity building and training, etc.

It has been agreed to use a main planning horizon of 30 years, with greater detail for the next 5 years and some strategic consideration of the longer outlook beyond 30 years. The planning process is designed to be periodically updated in a rolling manner, for instance every 3 to 5 years.

3.3 Data Collection

3.3.1 Approach

The Phase 1 Scope of Work described the intended approach to the data collection activity:

'The consultants will rely on the Iraqi ministries and other institutions for nearly all data collection work. Much of the necessary data is already available on paper or in electronic form, and the institutions will need to make staff time available to find it, collect it, collate it in convenient form, and transmit it to the team members abroad. Counterpart staff assigned to this work will need not only time but also the necessary authority to obtain data from people and offices that keep it; they will thus need strong support from senior levels in the ministries.'

'Information will be entered into electronic files of appropriate format by the data collectors wherever possible, and where this is not practicable it will be sent on paper to the analysts for entry into data files.'

The data collection exercise started with a long list of typical data required for strategic planning and a large number of data proforma developed by the consultants. Each ministry was provided with a copy of the General Scheme Stage 2 report on CD so that they could see what data had been presented and how it had been used in the development of the strategy that was described in the report. It was made clear during discussions with ministry staff that the SWLRI project was initially seeking the same type of data as had been collated and presented in the General Scheme Stage 2 report in order to undertake a similar strategy development study. The feedback loop where the exercise of developing and testing models and analytical tools identifies new data requirements to be met (see Figure 1.1) was also emphasised from the start.

Monthly data collection meetings were held to provide an update on progress. In September 2005 each ministry nominated a Data Collection Leader who was given the responsibility for providing the link point between his ministry and the consultants team.

3.3.2 Claromentis

At an early stage in the project it was decided that a web-based collaboration system was essential to the proposed data collection activities, and would be a tool for helping to build strong links between the stakeholders and to provide opportunities for other ministries to benefit from the project's activities.

Claromentis, was selected to act as the project data repository and email system. To encourage participation and eventual data sharing Claromentis has been designed to give each ministry a secure extranet area which has been customised for them. In this area set aside for them each ministry is able to manage its own data.

The SWLRI data collation system Claromentis has been received well by users. Its user friendly interface and logical layout has resulted in rapid adoption by many of the ministries and external collaborators. The system was licensed for 100 users and towards the end of Phase 1 this number had almost been reached, over half of whom were ministry users. Many ministries accessed the system on a daily basis to see what had been added and there was a progressive increase in the number of uploads and downloads that they made.

At the end of Phase 1 there were over 13,000 items loaded onto the system (September 2006), the majority of which are items of data. The following table shows document quantity based on application type:

Table 3.1:Status of Documents of Claromentis (end September 2006)

Application type	Documents Quantity
Unknown Document Format	513
RAR-compressed Archive	2
ZIP-compressed Archive	193
Microsoft Word Document	505
Microsoft Excel Document	2652
HTML (HyperText Markup Language)	55
CompuServe Bitmap Image	1
JPEG Image	9570
Text Document	11
Adobe PDF (Portable Document Format)	206

At the end of Phase 1 ARDI handed over the role of Claromentis Administrator to an IT specialist from MoWR and the hardware was transferred to Baghdad.

3.4 Data Compilation and Checking

3.4.1 The Data Repository

Most of the items submitted by the ministries to the SWLRI team were hard copy that subsequently had to be scanned, hence the preponderance of JPEG images in the Claromentis data repository (Table 3.1). The Phase 1 Scope of Work had envisaged that a much higher proportion of the data would be provided in digital format such as Microsoft Excel spreadsheets, tables in Microsoft Word or text files. As a consequence the ARDI team to support the data collection exercise was both expanded and kept in place for considerably longer than originally anticipated to cope with the workload of scanning and uploading images. The scanned image format, while useful for storing information, does not allow the data to be analysed directly.

Given the security problems that have affected the country the simple fact of creating an electronic record of such a large body of original paper data records is a very valuable precaution to safeguard the data. Therefore the ARDI team have scanned all material handed over to them by the ministries even when in some cases the material may not have been of immediate relevance to the SWLRI Unit.

The scanned data sheets have been uploaded to Claromentis either by the relevant ministry or by the ARDI team. The data has been reviewed remotely by other members of the ARDI team and comments, questions and further data requests have been passed back to the ministry Data Collection Leaders via email, occasional telephone conversations, and more importantly through the regular data collection meetings.

Many of the queries back to the ministries related to the lack of geo-reference information. In many cases it is necessary to know the location of sites where data has been recorded. This has generally been given as a description and grid references are required to make more effective use of this information.

Data was also requested and received from other project teams. Such data has not been subject to any further checking.

3.4.2 Generic Quality Control Procedures

The nature and extent of the quality control checking depends on the technical field. It was recognised that in the time frame of Phase 1 it would not be possible to complete full quality control on all the many data types required for strategic planning. However, procedures should be put in place to ensure that routine QC was established and standards were as high as possible.

In all cases the data must be finally signed off as 'acceptable' before it can be accepted as part of the strategy database. MoWR must have the final say in this as the principal end users. A staged approach to acceptance was proposed and was discussed at the January 2006 Steering Committee meeting. Some of the concepts, familiar to those with experience of working within Quality Assurance systems, such as keeping an 'audit trail' with individuals signing off their work were the subject of considerable debate. The conclusion was that introducing QA procedures identifying individuals would have to be a gradual process.

In reality it is highly desirable that QC of data should be undertaken by the ministry that is providing the data to the SWLRI Unit. For example, the Ministry of Municipalities and Public Works has experienced engineers who can, and should, review the data on water treatment works capacity and performance, and decide upon appropriate design criteria for consumption for different types of consumer. The SWLRI Unit does not have staff with the same experience and therefore should not be attempting to QC data without discussions with the data provider.

With this in mind a generic staged QC process is described below that can be adapted to suit the particular characteristics of the data under examination. For example, the QC procedures for hydrometric data (meteorological, river level and flow, groundwater level) are well established with specialised software to aid the process (HEC's DSS software) and so will differ from the QC procedures appropriate to checking agricultural crop statistics. The use of DSS, and the QC exercise on the hydrometric data that was used to develop the Tigris-Euphrates ResSim model, are fully described in Annex 17.

The generic QC process is outlined in Figure 3.1.

Figure 3.1: Generic Quality Control Process

Receipt of Incoming information
Who from?
What format is it in (spreadsheet, word, GIS layer, JPEG etc)?
Where is it stored on Claromentis?
If hard copy, where is it stored, and when does it have to be returned by?
Does it need scanning? All pages? If not all, identify which to be scanned.

NON-TECHNICAL CHECKING – Level 1
After scanning
Check all original pages have been scanned and are legible
Where is the scanned version stored on Claromentis? – this is now the original, 'raw' data

Conversion to digital format (by Optical Character Reader or typing in)
Check that the data entered matches the original
Where is the digital file stored on Claromentis? – if this matches the scanned version exactly it is also the original 'raw' data

TECHNICAL DATA CHECKING/REVIEW – Level 2
Initial review to identify suspicious data – *record suspicions in note form*

- Do the daily values sum to give the monthly value?
- Do the monthly values sum to give the annual value?
- Are units of measurement clear and any conversion factors correct?
- Plot graphs (if appropriate)
- Compare to previous years for same data
- Compare to any equivalent data received from another ministry or seen in a technical reference or report
- Pass the data and all checking records *plus your notes* to a senior officer for review

Senior review to advise on additional checks, or to correct any mistakes made in the checking process.
If suspicions remain: contact the originating ministry data collection leader, or directly to the department responsible for the data if known
Request them to QC the data set themselves (they should have internal procedures for QC and they also have the specialists for that particular data type who can give an expert opinion on the reliability of the data) – *check the digital file 'out' on Claromentis*
If they withdraw the data and reissue a corrected data set – *upload revised data file and Claromentis will record the version change. Add a note to the old file version to say why superseded*
If they confirm the data as reliable – SWLRI Unit must make a judgement
If they are unwilling to assist – SWLRI Unit must make a judgement

SWLRI UNIT ACTION
How important is this particular data set?
If needed for current work to progress – SWLRI Unit must adjust or revise the data
If not essential – *check the file back in on Claromentis unchanged and alter the meta field to record that the information is still under suspicion*

ADJUSTING OR REVISING THE DATA – Level 3
If the data is of a very specialised nature the SWLRI Unit should seek expert advice (within the MoWR, local experts, or consultants)
Otherwise the senior staff member will need to use their skill/experience to adjust or revise the data – *recording what changes were made and why*
Check the revised file onto Claromentis so that a new version is created and add a to the note field the reason for the changes and who made them and when.

3.5 Data Assessments

3.5.1 Introduction

The assessments described here review the collected data only in terms of their suitability for the needs of the SWLRI Unit for its planning activities. The descriptions are by field rather than by ministry because a number of data types are collected by more than just one ministry – water quality data is an example being collected by at least three ministries. More detail is presented in Annex 1, or, where the data is highly relevant to the development of the Tigris-Euphrates Water Management System Model, is presented in Annex 17.

Geo-referenced data was sought at the outset because of the ease with which erroneous data can be identified once it is plotted especially if plotted against a satellite image or topographic map background. It was apparent at an early stage that geo-reference (grid reference) information was rarely available and that there was a reluctance to share any available GIS information. The GIS strategy discussed in Section 4.3 took a different approach by providing training and other support to the GIS capabilities of individual ministries to geo-reference their own data and to be responsible for the quality control process.

3.5.2 Water Control Infrastructure

Information describing the major water control infrastructure has been collated and checked by HEC and the MoWR in the course of developing the Tigris-Euphrates ResSim model.

Information on the status of irrigation schemes is however incomplete. For example, no GIS layers of irrigation schemes and their associated control structures and pumping stations were available and the ARDI consultants have started the task of developing these essential maps for the MoWR GIS Section to complete – this will depend on obtaining geo-references for most of the structures. During the Study Visit in June 2006 the MoWR visitors attempted to improve upon the scheme status data sets and progress was made. This is an area where the SWLRI Unit need to press for complete data.

3.5.3 Meteorological Information

Most of the meteorological information obtained during Phase 1 was transferred from another ARDI component the AEZ (agro-ecological zones) pilot project with the Ministry of Agriculture. The data was not separately reviewed for SWLRI because it had already been assessed and accepted for use by the AEZ project.

3.5.4 River Flow and Reservoir Operation Data

HEC have carried out a comprehensive assessment of the available data in collaboration with staff of MoWR. This is reported in detail in Annex 17. Their assessment covered all the data types required to build and test the Tigris-Euphrates WMSM, but only for locations relevant to this model or the pilot ResPRM model of the Diyala basin.

3.5.5 Agricultural Information including Water Use

Agricultural data has been provided by the Ministry of Agriculture generally excluding the northern governorates, data from these has been provided by the Kurdistan Regional Ministry of Agriculture and Water Resources. The information from these two sources is difficult to compile into single data sets for the entire country because different parameters or different record periods have been supplied. In the planning context there is a need to develop an understanding of trends over time in the choice of crops, planted area for each crop, and yield (production). Some of the data is suitable for such trend analysis on a governorate basis (see Annex 1).

There is at present no data on crop production from individual irrigation areas.

There is no data on the quantity and quality of irrigation return flows from individual schemes.

3.5.6 Groundwater

Two Governorates – Sulaymaniyah and Erbil – provided most of information due to the fact that groundwater development has been most intense there from 2000 onwards. The development was a result of an FAO initiative. The MoWR provided about 3,600 scanned well cards – short descriptions of basic well data including coordinates, total depth, static water level, pumped water level, an outline lithology and some basic water quality parameters.

The Groundwater Studies Centre is currently undertaking work to install and operate a nationwide monitoring system. However, it is still not clear what is being monitored in 2006 and what had been monitored in the past, although there is rather more information for Erbil and Sulaymaniyah than elsewhere.

The MoWR GIS centre appears to have a number of geological and hydrogeological features mapped including well locations, presence of saline groundwaters, and water table depth, but these have not been made available in digital format for the ARDI team to perform independent checking.

3.5.7 Population Statistics

These were obtained as expected from several sources, many of which were consultants' reports. The SWLRI Unit should liaise with the Ministry of Planning and Development Cooperation to ensure that such parameters as estimated growth rates that SWLRI will be using are consistent with those used by MoPDC. The checking undertaken during Phase 1 of the data obtained has been limited to cross checking between sources, the national 10 yearly census being taken as the most reliable source.

3.5.8 Water Supply Information

The Ministry of Municipalities and Public Works (MMPW) has provided a list of water treatment plants, wells and compact units for 15 governorates. There is no equivalent data for the three Kurdish governorates of Dohuk, Erbil and Sulaymaniyah. Data for each facility include location given by coordinates, planned output, actual output and numbers of people served. From discussions with MMPW it is understood that the list is probably far from complete, although it is believed to be the most comprehensive list available. There is a reasonable correlation between the number of water treatment plants in the list and those recorded in specific plans for individual governorates, but the number of compact units (CUs) varies widely. It appears that CUs are put in by various organisations without any real coordination or record keeping

A weakness of the MMPW list is that it does not indicate which town(s) each treatment plant serves, nor the source of water for each works. There are coordinates for the location of each works, but these are unreliable, and in any case the treatment plant does not necessarily serve the area in which it is located, or the source of raw water may be far from the works.

Analysis of per capita consumption (pcc) from data for outputs and people served in the MMPW list shows a very wide range with many anomalous figures, e.g.

> For water treatment plants, the calculated pcc varies from 24 to over 10,000 litres per person per day (lpcd).
>
> The variation is even more extreme for CUs.
>
> In 8 governorates (over half of those for which data are supplied) the average pcc is 333 lpcd for all works. The governorates with this figure throughout are Al Anbar, Baghdad, Basrah, Diyala, Maysan, Muthanna, Qadisiyah and Salah al Din. We assume that 333 is a target figure for supply, and population served is calculated from measured/estimated works output or actual output is calculated backwards from population served.

There are a number of consultants' reports which present differing figures for per capita demand all of which purport to be agreed with MMPW.

There is more detailed discussion in Annex 1.

3.5.9 Hydropower Information

The collected data was almost complete and was used successfully to build and test a workbook for hydropower energy and power calculations. The data set would have been complete but for some untidy scanning which meant that the static head values for a number of installations were missing. This missing information has been requested.

3.5.10 Water Quality and Pollution Information

Hand-written water quality record sheets were received for various monitoring points on the Tigris and the Euphrates. The periods of data covered in the records are shown in the following table. The time interval between samples varied between the monitoring stations, and also over time at each station varying between monthly data and as frequent as daily data for some periods of record, although there are extensive periods of missing data. The lengths of the data sets shown below are for the salinity or conductivity data records although further data series are present at most sites for other water quality parameters. This inconsistency in sampling frequency has consequences for the suitability of the data for some uses.

Table 3.2: Availability of Water Quality Data Series for River Monitoring Points

River	Location	Period of Record
Tigris	Srai Baghdad	1971-2000
	Amara	1977-2002
	Baghdad	1979-1990
	Mosul	1971-2001
	Samarra Barrage	1974-2001
Shat al Arab	Al Qurna	1971-1990
Euphrates	Al Hindiah Dams	1971-1998
	Al Ramady Dams	1971-2001
	Al Samawah	1973-2002
	Di Qar	1978-2002

None of the monitoring points was given a grid reference to show precisely where the sample had been taken. In fact 23 other record sheets were available but the gauging locations were not clearly identified on the sheets.

These monitoring points are all on the main river systems. No data has been collected during Phase 1 that relates to the water quality in lakes and reservoirs, or any measurements giving the quality of waters in the canal and drainage systems. Information on the quality of drainage returns is of particular interest for agricultural planning and the lack of data is surprising.

The lack of water quality data was a constraint to the development of models during Phase 1. There is more discussion of these issues in Annex 1 and Annex 11.

3.5.11 Environmental Information

The main sources of information collected on environment in Iraq are UNEP, the Marsh Restoration Program and the New Eden Project. All of these have used experts from the local universities to provide material on habitats and species of interest. The future of the southern marshes is obviously a key issue for the strategic studies to be undertaken by the SWLRI Unit but there appears to be a considerable body of recent data from other projects to work from. Obtaining good data covering the period before the draining of the marshes is more problematic.

3.5.12 Opportunities Data

The limited data on opportunities was reviewed with the visiting MoWR staff in May/June 2006 as part of the process of developing the Iraqi multi-criterion decision model (MCDM).

From these discussions it appeared that most of the projects had been proposed at the time of the General Scheme Stage 2 (Russian report, 1982) and had not been taken further since then. This suggested that a major exercise would be required to check the existing engineering designs, to revisit the economic analyses, and to prepare environmental impact assessments and any other studies that might be required if the project were to be considered a candidate for international donor financing (e.g. World Bank safeguards policies).

3.6 Recommendations

3.6.1 Data Sharing Arrangements

Data is fundamental to the planning process and it is essential that efforts are made to build on the improving culture of openness to data sharing that Phase 1 has strongly promoted, preferably by establishing formal protocols.

The Data Collection Leaders proved very useful to the ARDI and SWLRI staff allowing them to focus their efforts more effectively. It is recommended that the role of Data Collection Leader is retained (possibly under a new title) into Phase 2.

During Phase 1 it became apparent that there was some data that needed to be collected at governorate or district level. The mechanism for passing data requests from the SWLRI Unit to say governorate level needs to be considered. At present all requests are routed through the Data collection Leader but they may not have the authority to direct governorate staff to provide the data.

During Phase 1 the Claromentis system proved an effective route to get data transferred between ministries. This depends upon the security settings and permissions that are set by the Claromentis Administrator. It is recommended that increased access should be allowed where possible.

The situation in the upper catchments is of great interest to Iraqi planners. How to get data from the upstream neighbours as a matter of routine is something that needs to be explored. Presentations during the shorter study visit covered case studies on promoting transboundary data sharing.

3.6.2 Quality Control of Data

This is linked to previous section, in that QC of data should be undertaken by the home ministry not by the SWLRI unit who have neither the resources nor the experience to do this as well as it could, and should, be done by the home ministry.

In the case of GIS activities, the concept from the start has been that the MoWR should assist the other ministries to provide reliable geo-referenced data to the SWLRI unit by training them and by setting standards for QC procedures. Every opportunity was taken to reinforce this message and while it is too early to say whether the approach has been successful it seems to be the right model for the future because it should be sustainable.

3.6.3 Further Data to be Collected

The process of building and testing the models and analytical tools during Phase 1 has highlighted the fact that in most cases other information is still required in order to be able to complete the testing and to make full use of the Phase 1 tools in the future. Two examples have been selected to show where the lack of information available in Phase 1 has been a constraint: the use of the Iraq Multi-criterion Decision Model (Section 5.2), and the water quality model (Section 5.4).

Another particular area is the need for agricultural data records for individual irrigation schemes rather than just accumulated figures for administrative regions. This would allow the link between water supplied and actual yield of crops to be fully explored.

4 Planners Toolkit

4.1 Introduction

4.1.1 Planners Toolkit

Just as a workman's tool box contains a variety of implements so the SWLRI planners toolkit is made up of a number of types of tools and within a particular type there may be several items, some of general use, some very specific. Some tools have been developed during Phase 1, others have been prepared by others and have been included in the toolkit because they are highly relevant to the SWLRI objectives. The toolkit should continue to develop in the future.

The toolkit presently contains four types of tools:

- Reference material: relevant reports and papers, links to web sites, best practice examples etc
- Software: modelling packages, bespoke models, and their associated manuals
- SWLRI technical reports and guidance notes
- SWLRI templates and worked examples

The development of bespoke models has been a key part of Phase 1 and these are highlighted below.

The SWLRI technical reports and guidance notes form the start of a series of occasional publications addressing issues relevant to strategic planning for the sustainable use of the water and land resources of Iraq. The distinction between the two series is on the basis of function: technical reports describe work undertaken, discuss results, and make recommendations, while guidance notes are highly focussed, often short, documents that give advice, instructions, and warnings on how to use a model or technique and to interpret the results. Generally there is a guidance note to accompany any modelling software developed for SWLRI.

4.1.2 Development of Tools for Planning

Iraq's highly developed system of reservoirs, barrages, and irrigation facilities offer many possibilities for managing the nation's water resources, while ongoing upstream development in Turkey, Syria and Iran introduces significant uncertainty into any comprehensive planning analysis. Modelling studies of water volumes and quality have therefore been key components of the Phase 1 program. However, the development of other models and analytical tools to support the overall strategic planning process has also been an important activity. A selection of the more significant planning tools are described to illustrate the development work and the place of the tool in the 'toolkit', starting with the water management models. Some other tools are described in Chapter 5.

All the analytical tools developed are described in more detail in the annexes (refer to Section 1.4 for a listing).

4.2 Claromentis Site Map

From an early stage web-based collaboration has been seen as key to successfully allowing the widely dispersed project team to work together. All of the outputs of Phase1 have been put onto Claromentis in order to make them accessible to all the stakeholders – subject to the agreed security settings. However, since Claromentis holds over 13,000 items it is necessary to have a means of finding one's way around – the Claromentis Site Map.

The site map is summarised in Appendix A.

It is important to note the connection between this report and its annexes and Claromentis. The annexes largely consist of technical reports and guidance notes (see Section 1.4). On Claromentis these documents are available with any associated workbooks, modelling software or reference material that belongs with them. Thus the Guidance Note 03 'Irrigation Water Requirements', which appears here as Annex 9, is held on Claromentis together with the two workbooks 'Rice Diversion Requirements.xls' and 'Non-rice Diversion Requirements.xls' and the FAO CropWat package (with manual) that it refers to. All the elements of the toolkit that relate to the calculation of irrigation water requirements are therefore to be found together on Claromentis.

4.3 Modelling Water Resources Systems

This section to be written by HEC.

A very significant amount of work has been done on the development of models of the river and water control systems for both quantity and water quality. This is reported in detail in Annexes 17 and 18

4.4 Developing GIS as a Planning Tool

Maps and GIS tools are extremely important in strategic planning. Not only are they actively used by the planners but they are a vital component of the extremely important task of selling the resulting plans to others: politicians, other ministries, and the general public.

At the start of the SWLRI project in July 2005 GIS capacity was limited to a few small centres, the largest of which was the GIS Section within the MoWR. From the start the SWLRI team have emphasised the value of using maps and GIS tools to assist in strategic planning work. In February 2006 the first GIS Cluster meeting was held with representatives of 11 ministries in Erbil to raise awareness of the potential of GIS tools and to start a collaborative process by which all ministries contributing to SWLRI Phase 1 would develop their GIS capability and move towards adoption of common standards to facilitate future exchange of data.

A strategy for developing and maintaining a suite of GIS tools and map products for use by the SWLRI Unit, and for establishing formal mechanisms for sharing expertise and exchanging data, is under preparation in collaboration with MoWR and the other ministries.

The draft strategy addresses the following topics:

- Agreement on standard software

- Appropriate structure for information
- Identification of data exchange mechanisms and quality control processes to ensure the reliability of data being exchanged
- Evaluating training needs at each of the participating ministries
- Evaluating hardware and software needs at each ministry
- Developing mutual professional support mechanisms.

The strategy is presented in Annex 2.

A number of GIS products have been started by the SWLRI team to demonstrate the type of products needed by the SWLRI Unit. These include a map showing formal irrigation schemes and areas of traditional irrigation being drawn up on the basis of digital layers for canals and ditches and LandSat imagery. This could be overlaid with a layer showing the location of nodes in the Tigris-Euphrates ResSim model (also produced) to help planners to relate schemes and other water uses to the WMSM. The irrigation scheme layer would then form the base for maps of saline or waterlogged soils, maps of crop production etc. A layer of the General Scheme Stage 2 climatic zones has been produced that can be used with the irrigation scheme layers to provide the SWLRI Unit with a means of determining which crop water requirements values to use. Similarly the AEZ (agro-ecological zone) mapping piloted by ARDI with Ministry of Agriculture can in the future be linked with the irrigation scheme layer, again in order to aid the SWLRI Unit in choosing appropriate cropping patterns.

Great importance is attached to getting the GIS teams at all the ministries to collaborate but it is also vital that the GIS specialists consult with the SWLRI Unit and other end users of their products to ensure that what they produce is really useful to the planners.

4.5 Multi-criterion Decision Model for Iraq

4.5.1 Introduction

The model should be built with the maximum possible participation from stakeholders. In the case of SWLRI an opportunity arose in the form of the 6-week Study Visit by staff from MoWR and the Kurdistan Regional Ministry of Water and Agriculture. The visitors worked with some assistance from the consultants to develop the MCDM for Iraq in its first formulation. It is recognised that the process of building the MCDM is strongly influenced by who participates and by how well they can bring into the model the concerns and aspirations of other stakeholders who are not represented.

A Guidance Note has been prepared (Annex 5), and the visitors put together a presentation of their results for the SWLRI Steering Committee meeting, which was the first opportunity for other ministries to judge the usefulness of the approach.

The steps in the process of building the MCDM are summarised below:

- Agree the criteria to be used to choose between project proposals and assign them a position in the hierarchy of the Value Tree (Figure 4.1)

- Develop scoring rules for each criterion shown on the Value Tree. Some will be quantitative and some non-quantitative (Figures 4.2-4.9)

- Give each criterion a weight to complete the Value Tree (Figure 4.1)

- Take a sample of projects that are typical of the type of projects that will need to be assessed in the future

- Use the MCDM (criteria, weights and scoring rules) and rank the projects

- Review the whole process and the results to determine whether the MCDM as currently framed is suitable or needs some modification

The latter review should involve both the analysts and decision-makers reviewing all the features of the model, especially its scoring rules and weights. Although they resulted from a consensus earlier, the decision makers may reasonably wish, after seeing what priorities they result in, to adjust them a little. Adjusting weights, or individual scores of particular alternatives, is quick to do and the results can be displayed during a meeting and discussed. Changing a scoring rule takes much longer, since all alternatives have to be re-scored with the new version of the rule, and criterion weights may have to be reconsidered in the light of the new scale; such model changes would have to be done by the analysts separately and presented to a later meeting of the decision-makers. This iterative process can take some time, especially in the first year that a new sort of model is used, but after a few years the model should settle, and people should become more adept at managing it, so the iterative process should get quicker and easier.

4.5.2 The MCDM Developed May/June 2006 with MoWR

Figures 4.1-4.5 illustrate the criteria, weights, and scoring rules arrived at by the visitors from MoWR during the 6-week Study Visit to the consultant's offices in the UK.

Figure 4.1: Development of the Iraq MCDM Value Tree

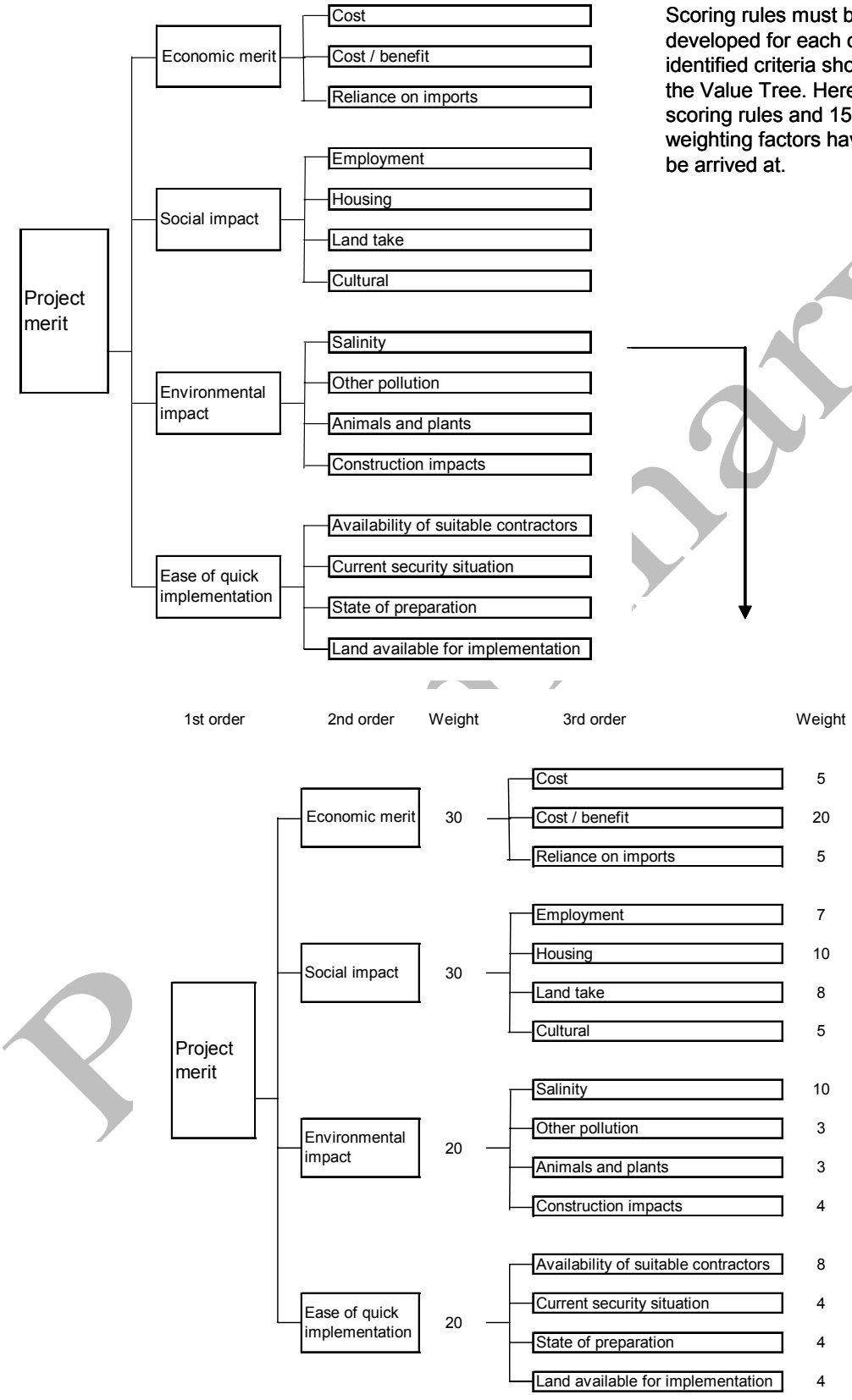
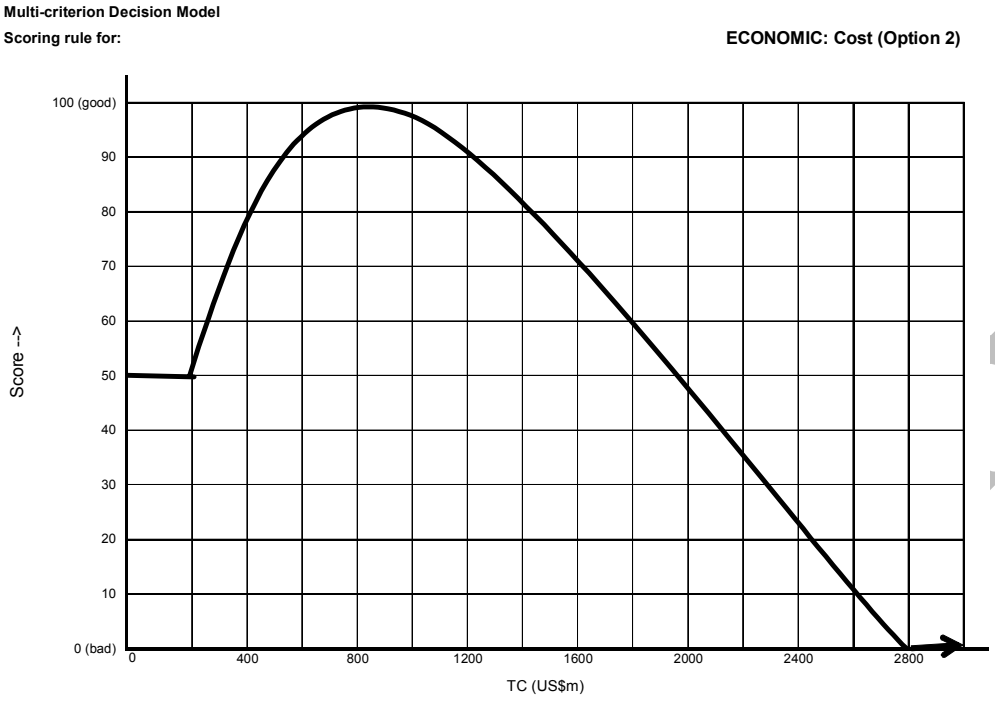


Figure 4.2a: Development of the Iraq MCDM Economic Criteria



TC = Total cost of intervention

Notes: Highest score given to projects with a cost of around US$800m.

Lower value projects score lower because more administration is needed.

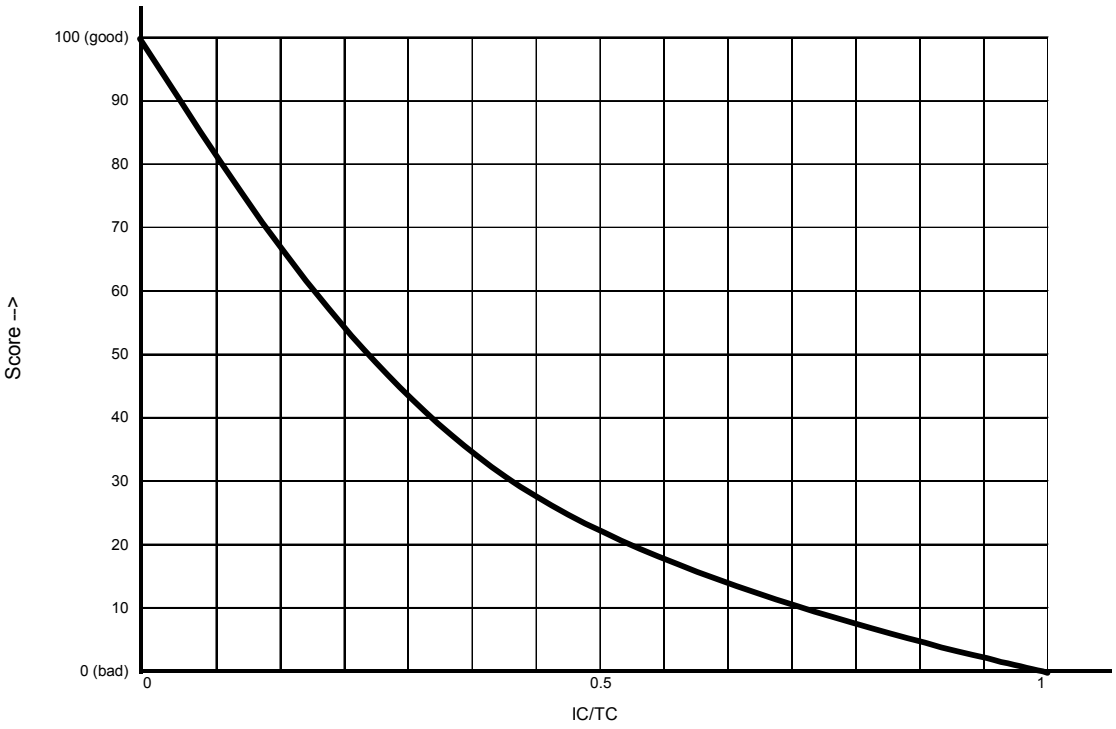
Higher value projects score lower because the benefits will not be distributed throughout the country.

(veto for B/C ratio less than 1.0)

Figure 4.2b: Development of the Iraq MCDM Economic Criteria

Multi-criterion Decision Model

Scoring rule for: **ECONOMIC: Reliance on imports**



IC = Import cost (US$m)

TC = Total cost (US$m)

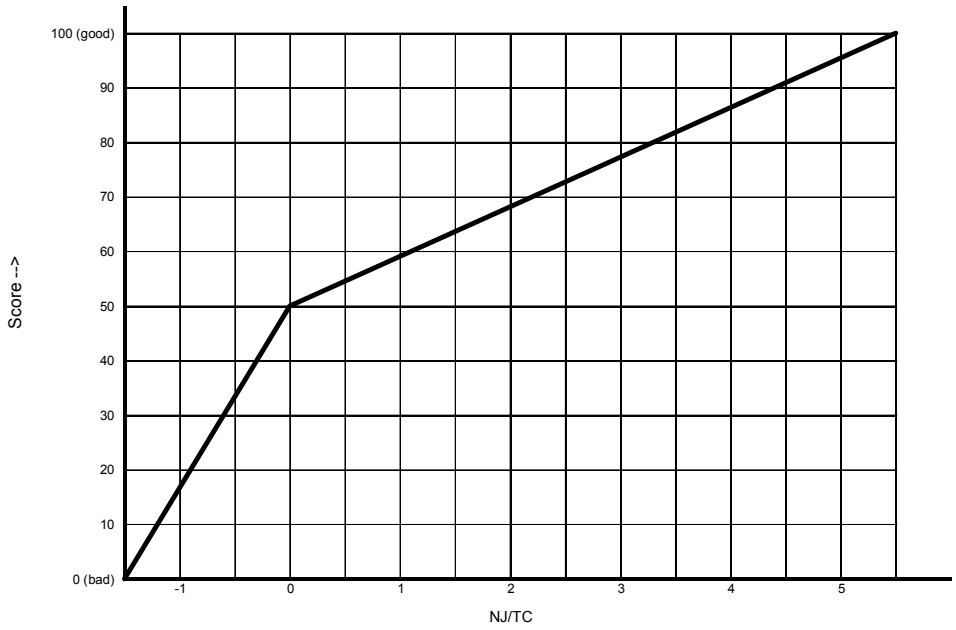
Notes Import cost must include 10 years supply of spare parts

Weighting for this criteria likely to change when there are fewer restrictions on imports

Figure 4.3a: Development of the Iraq MCDM Social Criteria

Multi-criterion Decision Model

Scoring rule for: **SOCIAL: Employment**



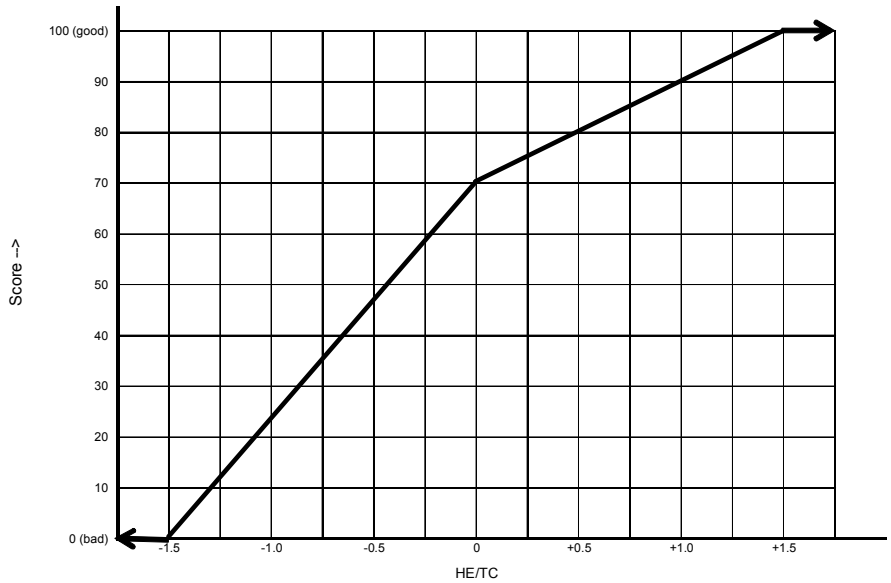
NJ = Number of long term jobs

TC = Total Cost of Intervention (US$m)

Note: Jobs lost - negative
Jobs created - positive

Multi-criterion Decision Model

Scoring rule for: **SOCIAL: Housing**



HE = Housing Equivalents

2 bedroom house	=	1	HE
4 bedroom house	=	1.5	HE
School	=	20	HE
Pump station	=	0	HE
Railway line	=	0	HE
Hospital	=	0	HE

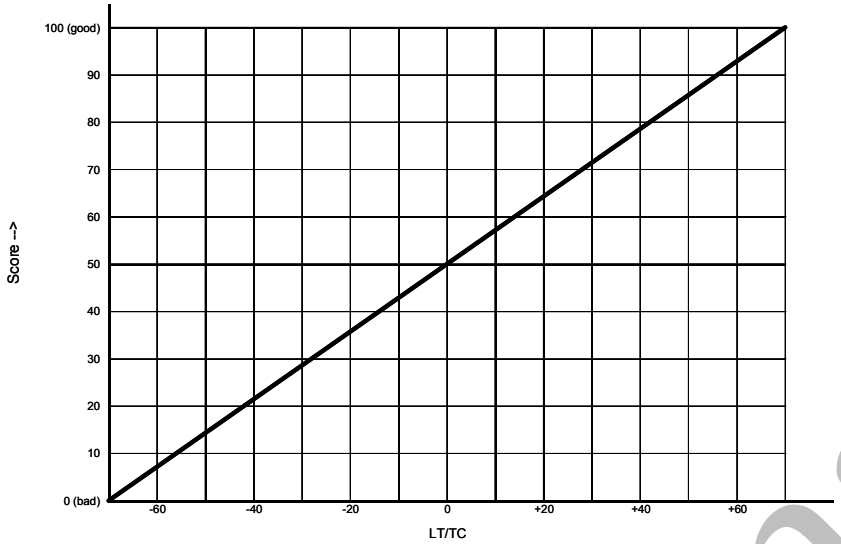
TC = Total Cost of Intervention (US$m)

Note: Houses to be destroyed - negative
Houses to be developed / saved from destruction or abandonment - positive

Figure 4.3b: Development of the Iraq MCDM Social Criteria

Multi-criterion Decision Model

Scoring rule for: **SOCIAL: Land take**



LT =Land take

LT = (1.0 x LA) + (0.4 x LB) + (0.8 x LC) + (0 x LD)

LA Area of land fully owned (don)

LB Area of land rented from govn. (don)

LC Area of land with partial private ownership (don)

LD Land not used (don)

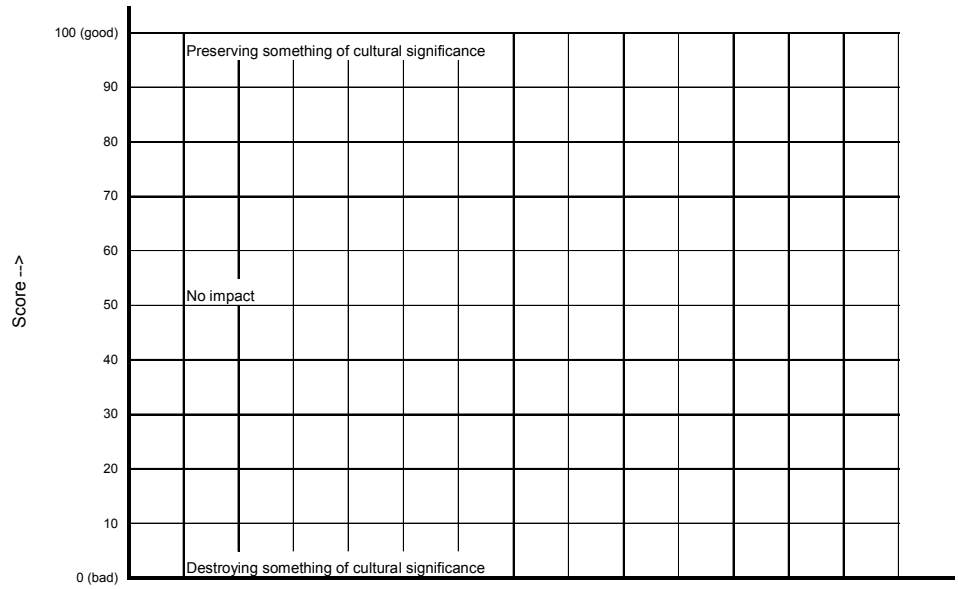
TC = Total Cost of Intervention (US$m)

Note: Land to be taken - negative

Land to be gained - positive

Multi-criterion Decision Model

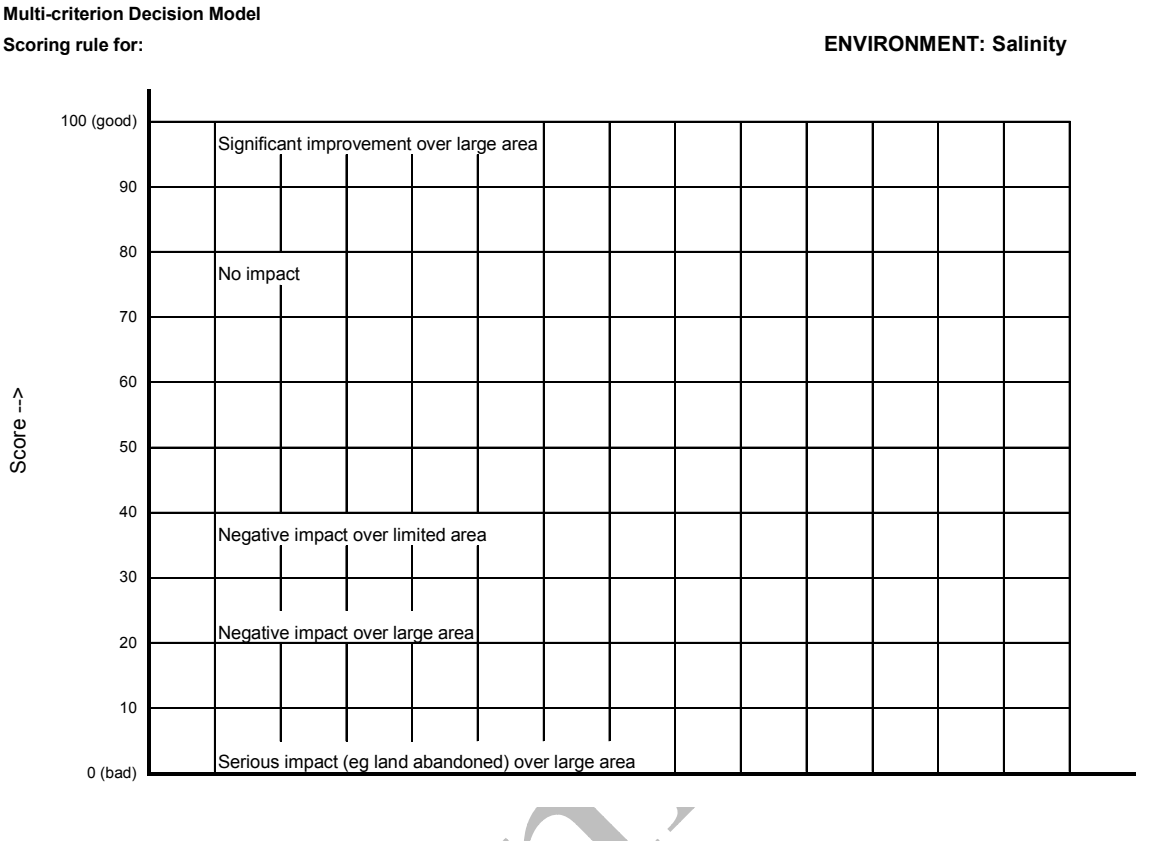
Scoring rule for: **SOCIAL: Cultural**



Items of cultural significance:

- Archaeological / ruins
- Religious sites
- Graves
- Temples
- Particular communities

Figure 4.4a: Development of the Iraq MCDM Environmental Criteria



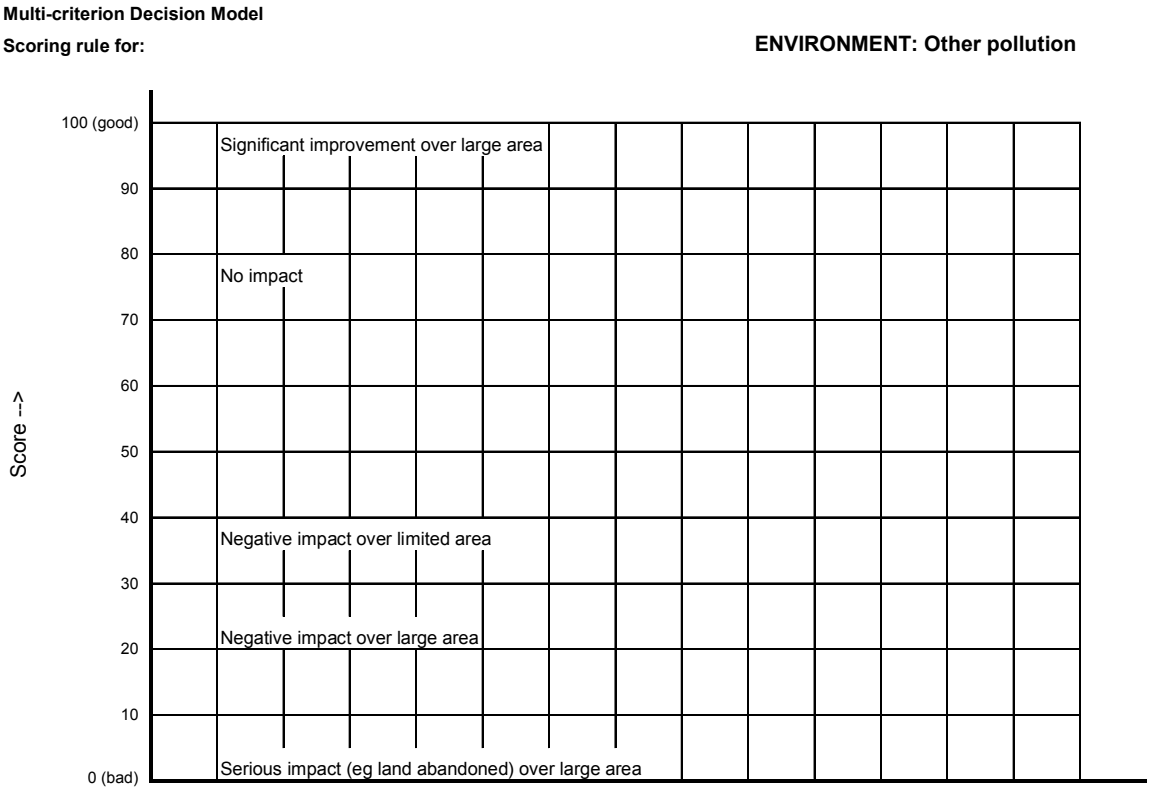
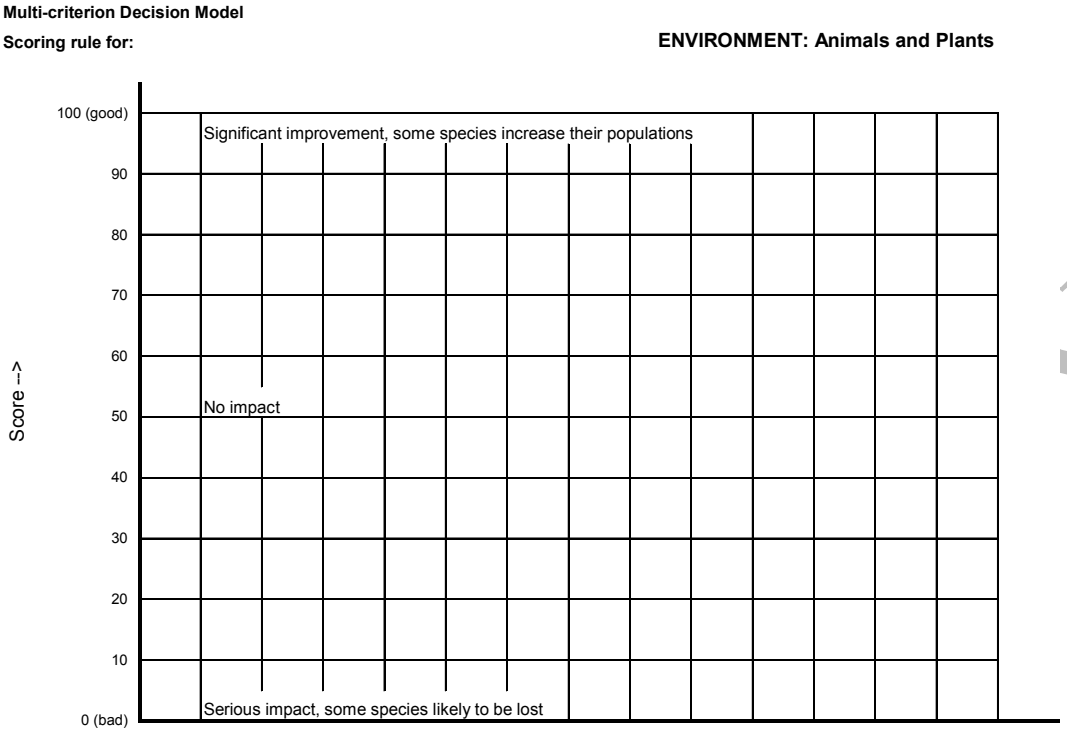
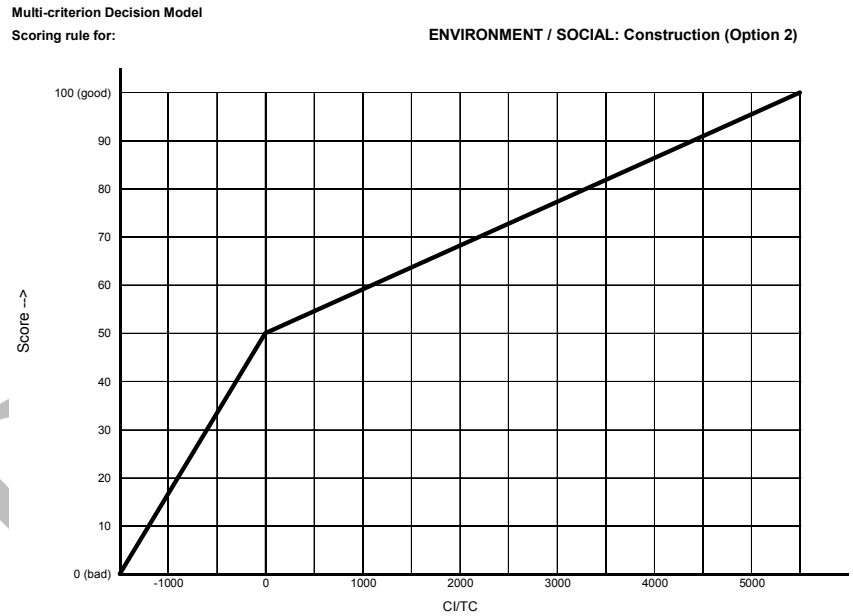


Figure 4.4b: Development of the Iraq MCDM Environmental Criteria





Possible approach for consideration:

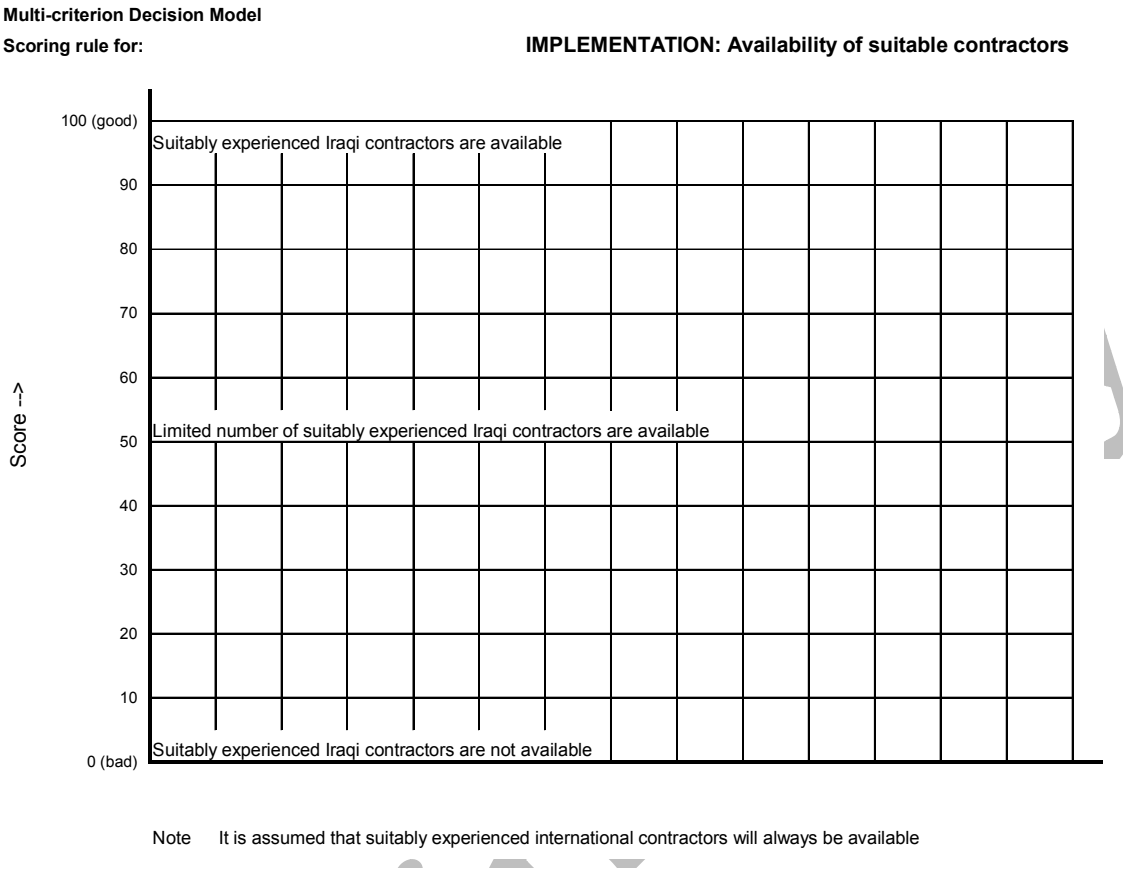
CI = (NP + TLT) x T TC = Total Cost of Intervention (US$m)

CI	=	Construction Impact
NP	=	People component
TLT	=	Temporary Land Take
T	=	Time (years)

NP = 1.0 x NP1 + 0.1 x NP2 + 1.5 x NP3

NP1	=	Estimated number of people to be temporarily relocated
NP2	=	Estimated number of people effected by construction noise and dust
NP3	=	Estimated number of people whose employment is disrupted

Figure 4.5a: Development of the Iraq MCDM Ease of Implementation Criteria



Note It is assumed that suitably experienced international contractors will always be available

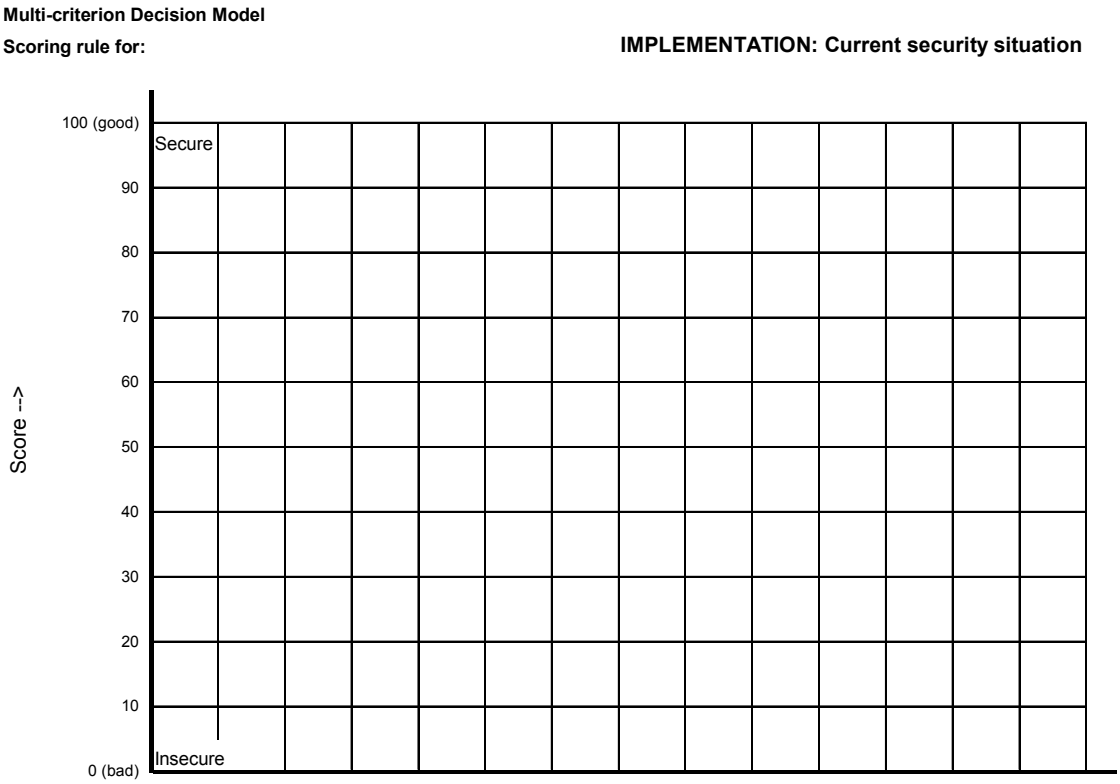
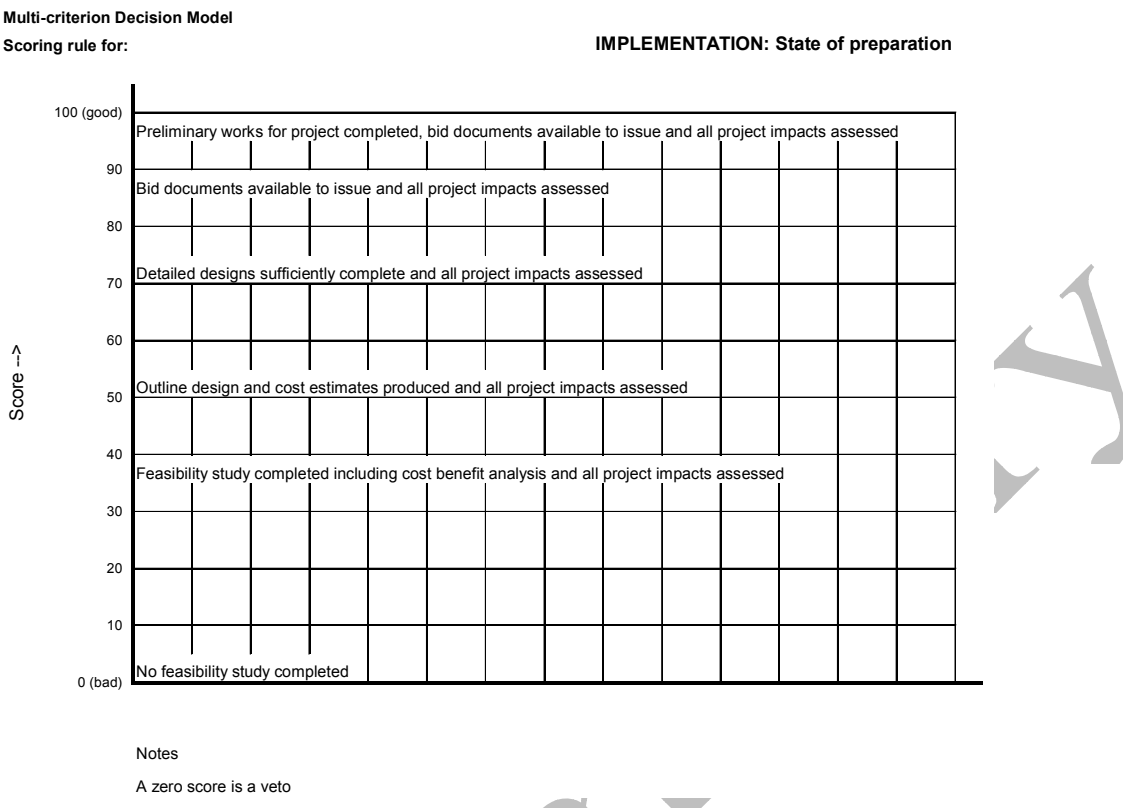
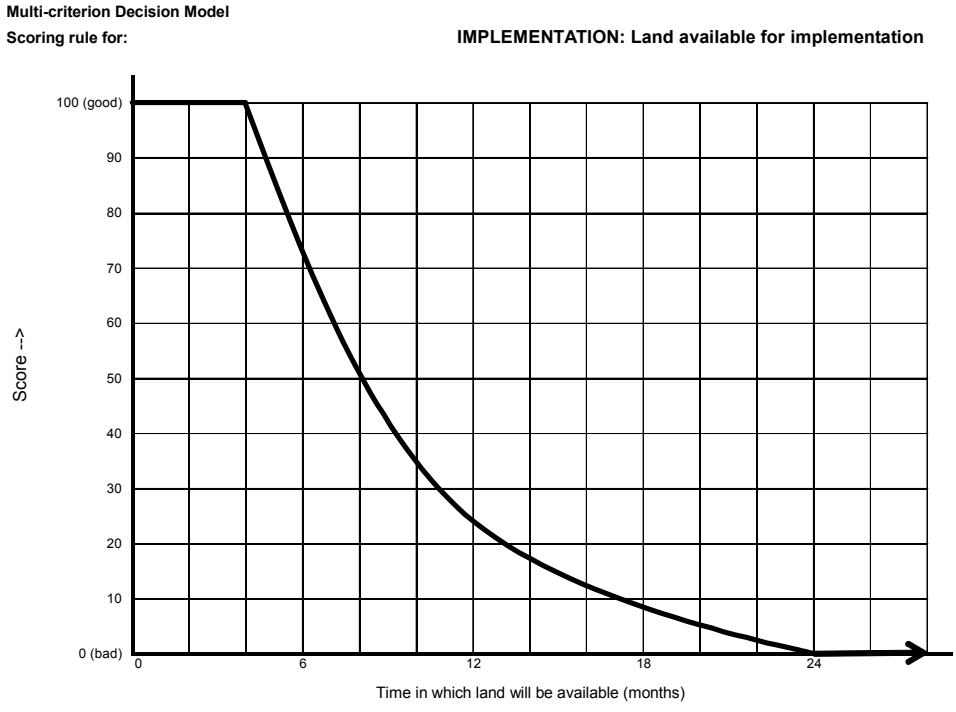


Figure 4.5b: Development of the Iraq MCDM Ease of Implementation Criteria



Notes

A zero score is a veto



Notes Time required should take account of:

Legal constraints

Administrative constraints

Resettlement

4.6 Water Supply Demand Forecast Workbook

A workbook has been developed to hold details of existing water treatment works and to calculate demand forecasts for municipal and rural water supply. The workbook has been populated with data from the Ministry of Municipalities and Public Works and their consultants, but the data set is incomplete at the present time.

The workbook is described in Annex 13 and the results are described in Section 5.5

4.7 Hydropower Demand Forecast Workbook

A workbook has been developed to hold details of existing and proposed hydropower schemes and to calculate demand forecasts for energy and power. The workbook has been populated with data from the Ministry of Electricity but the data set is incomplete at the present time.

The workbook is described in Annex 15 and the results are described in Section 5.6

4.8 Other Tools to Aid the Planning Process

4.8.1 Categories

Three categories can be identified

- Pre- or post-processing tools to prepare data for use with one of the larger models, or to improve the presentation of output.
- Checklists and lookup reference material
- Outline contents lists and generic terms of reference for studies, management plans, environmental assessments etc

4.8.2 Data Preparation Tools

The tools provided in this category include workbooks and a guidance note (Annex 9) to cover the preparation of irrigation water requirements that can be used either as a stand alone tool to compare the requirements for two varieties of the same crop with different length growing seasons or to assess the change in water use for changes in cropping pattern, or used to prepare data for a new scheme or new cropping regime on an existing scheme to be used in conjunction with the WMSM.

The farm budget workbooks and guidance note (Annex 8) provide inputs for subsequent economic analyses.

A number of the suggested maps (Annex 2) will be used by the SWLRI Unit when preparing data for testing scenarios.

4.8.3 Reference Material

In the course of their work the ARDI experts have identified a number of useful references and web sites. These documents have been organised and put into a reference library section on Claromentis (see Appendix A).

5 Demonstration of the Planning Process

5.1 Introduction

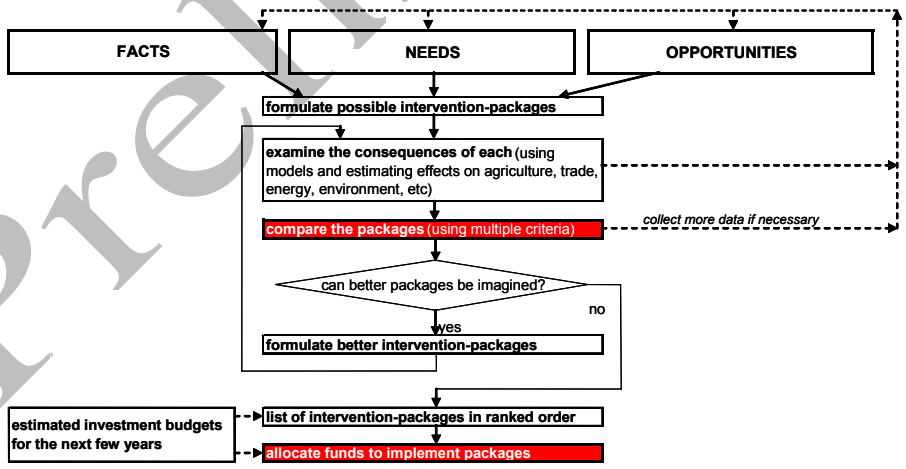
Phase 1, running from June 2005 to September 2006, focused mainly on Stage A, but a start was made on Stage B from May 2006. The full strategy will be developed in later phases.

The two study visits (described in more detail in Section 6.3 below) were key to the process of demonstrating both the planning processes being suggested and also the operation of some of the planning tools being developed for the use of the SWLRI Unit. During the visit focused seminars covered subjects such as multi-criterion analysis (MCA), project cycle planning for international funding, and stakeholder participation. Case studies were used to illustrate the complete process of master planning, and best practice in a variety of spheres including irrigation and drainage techniques, water supply management, and environmental management.

In particular during the study visits the aim was for a joint government/consultancy team to use the SWLRI planning approach to start to evolve a strategy plan for the development of water and land resources in Iraq, by:

- examining the consequences of the selection of each of a range of possible intervention packages using models and analytical tools;
- preparing selection criteria;
- comparing the packages using multi-criterion methods.

Figure 5.1: Part of Stage B of the Planning Process



The following sections describe the testing of models and the demonstration of their use within the overall planning process.

5.2 Testing the MCDM for Iraq

As described in Section 4.3 the multi-criterion decision model for Iraq was developed with the active participation of MoWR staff on the 6-week study visit.

In terms of starting to develop preliminary intervention packages the approach was to demonstrate the multi-criterion analysis process on a range of typical interventions in the irrigation sector using information from the Ministry of Water Resources web site. The approach was to encourage the ministry staff to actively use the process on as many projects as possible.

As noted in the previous discussion on opportunities data there was a lack of detailed information readily available to the consultants team, and therefore to the visiting MoWR staff. For many of the projects on the MoWR web site lists there are project feasibility study or design reports held in the MoWR library in Baghdad. However, as discussed most of these date from the early 1980s or are even older, and so some of the information, particularly relating to costs, is likely to be out of date.

The testing during the study visits was therefore somewhat compromised by the lack of data, but with such senior and experienced visitors it was possible to make reasonable guesses in many cases in order to carry the process forward. However, the results described below must be regarded with some caution on this account. As noted elsewhere the study visitors have carried out further assessments since their return to Iraq and it is to expected that those projects that they have assessed in their own offices have had the benefit of access to the full study documents for each project.

The first assessments were carried out as part of testing the criteria that had been developed so two rather different projects were chosen to illustrate a range of types from the overall MoWR web site list. A further project, the East Gharraf Irrigation Project, was added during the second study visit, parts of the 1986 Feasibility Report by Gersar was available to support the analysis.

Table 5.1 shows the results presented by Mr Satar of MoWR to the July Steering Committee meeting in Erbil. Of the 10 selected projects for testing the Nahar Saad Reclamation Project scores the highest and is therefore ranked the top priority for implementation among the group of projects considered.

The project examined in this test ranged in size and cost from Bekhme Dam (estimated $ 515 million) to Babilo river lining (estimated $ 0.883 million).

It is a recommendation that in Phase 2 the SWLRI Unit should aim to introduce the MCDM to other ministries building on the interest shown at the Steering Committee meeting.

A guidance note on the use of the MCDM has been prepared and is contained in Annex 5.

Table 5.1: Preliminary Results of MCDM Analysis of MoWR Projects

criterion group	economic merit			social impact				invironmental impact				**Ease of quick implementation**			
group weight	30%			30%				20%				20%			
criterion	Economic B/C ratio	Cost	Reliance on import	Employ-ment	Housing	Land take	culture	salinity	Other pollution	Animals& plants	Construct-on impact	Avability of suitable contractors	Current security situation	State of preparation	Land available for imple-mentation
Criterion weight	20%	5%	5%	7%	10%	8%	5%	10%	3%	3%	4%	8%	4%	4%	4%
Bakhma Dam cns./514.5 m$	88	0	34	43	20	20	30	60	50	15	50	60	100	80	90
Hemreen Dam rehi./1.776m$	10	62	60	50	70	50	50	75	35	50	50	75	75	70	95
Canal Cleaning equi.133.0m$	50	65	0	52	70	50	80	75	60	45	48	0	90	85	100
Const.of 40 Kehreezs/1.m$	80	90	90	56	70	50	55	35	70	40	50	50	100	70	90
Babilo riverl lining/.883 m$	35	50	90	50	70	50	55	85	50	40	50	100	90	85	95
Hor Rejab reclamaition/5.250 m$	30	50	80	60	70	65	55	85	40	40	45	100	30	70	90
Nahar Saad reclaim./17.639m$	30	50	80	95	70	85	65	95	40	40	45	100	100	70	100
Razzaza P.S./4.526m$	10	50	0	50	70	50	55	75	70	50	45	50	50	80	100
G arraf Cross Reg. rehib.1.101m$	10	50	10	50	70	50	55	90	70	40	45	50	95	80	100
Al-Shinafia Drain Excavation/1000	30	50	90	50	70	50	55	75	70	45	45	70	95	70	100

	MULTI-CRITERION INDEX					**RANKING**
	GROUP CONTRIBUTION					
project	Economic	Social	environm-ental	impleme-tation	*OVER ALL MERIT INDEX*	
	max 30	max 30	max 20	max 20	100	
Bakhma Dam cns./514.5 m$	19.3	8.1	10	15.6	53	6
Hemreen Dam rehi./1.776m$	8.1	17	12.1	15.6	52.8	7
Canal Cleaning equi.133.0m$	13.25	14.64	12.57	11	51.46	8
Const.of 40 Kehreezs/1.m$	25	14.92	8.8	14.4	63.12	3
Babilo riverl lining/.883 m$	14	17.25	13.2	19.65	64.1	2
Hor Rejab reclamaition/5.250 m$	12.5	19.15	12.7	15.6	59.95	4
Nahar Saad reclaim./17.639m$	12.5	20.75	13.7	18.8	65.75	1
Razzaza P.S./4.526m$	4.5	17.25	12.9	13.2	47.85	9
G arraf Cross Reg. rehib.1.101m$	5	17.25	14.1	15	46.35	10
Al-Shinafia Drain Excavation/100	13	17.25	12.75	16.2	59.2	5

5.3 Testing the WMSM

5.3.1 Introduction

This section to be written by HEC.

A very significant amount of work has been done on the development of models of the river and water control systems for both quantity and water quality. This is reported in detail in Annexes 17 and 18

Two scenarios have been set up to demonstrate the application of the WMSM (ResSim):

- Scenario A, this models existing situation with the present levels of development both in Iraq and in Turkey
- Scenario B, this models the existing situation within Iraq but assumes complete build out of the proposed reservoirs and irrigation projects in Turkey on the upper Tigris and Euphrates

5.3.2 Scenario A

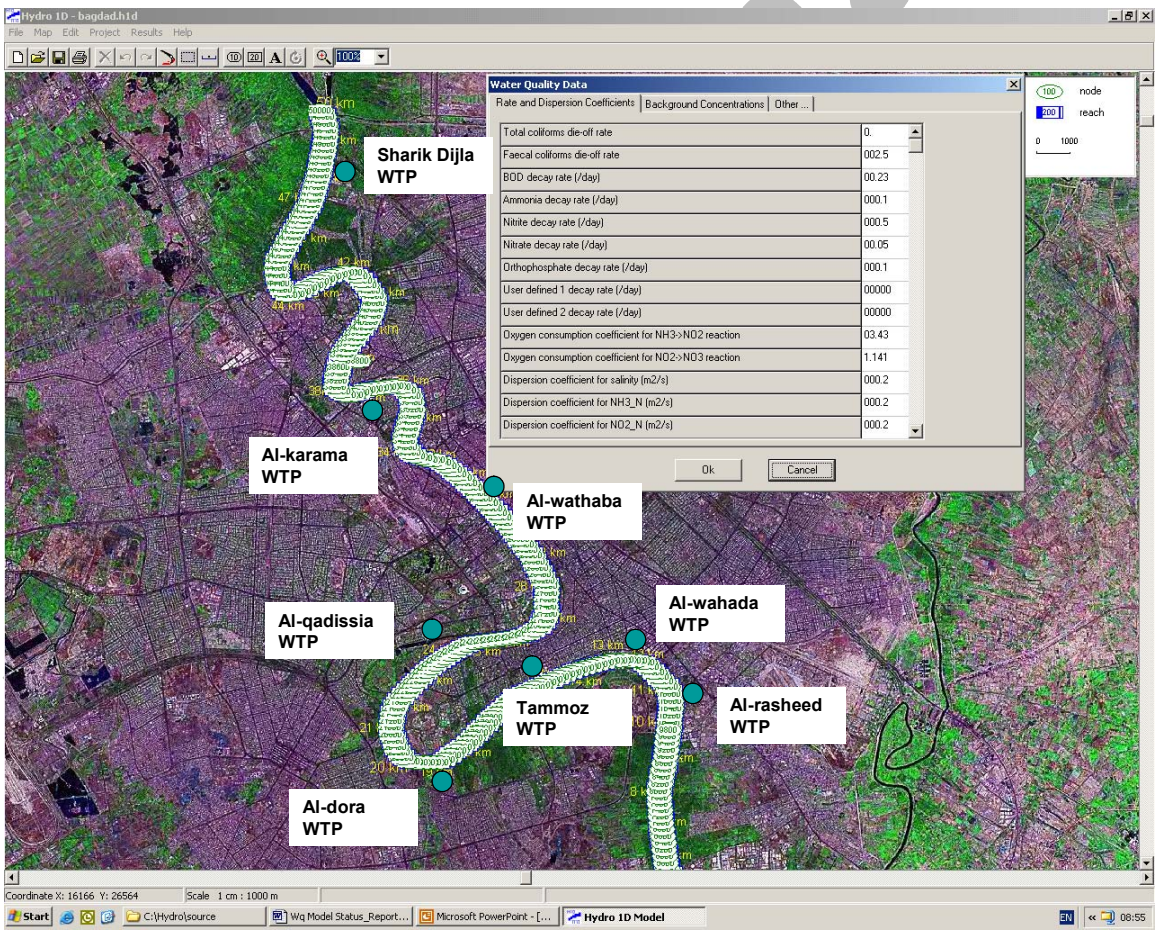
5.3.3 Scenario B

5.4 Testing the Hydrodynamic Water Quality Modelling Tool

The HYDRO-1D software was used to set up two test beds as part of the development of the salinity module that has been incorporated in the WMSM. A by-product of this work is the ability to demonstrate another application of the test beds, namely their use for the modelling of other conservative, or non-conservative, water quality parameters where the decay processes are known. Thus the test bed model for the Tigris reach through Baghdad can be used to demonstrate the impact of adding a point pollutant source, for example a waste water treatment plant (WwTP) effluent, during periods of low flows in the river on abstractions for nearby water treatment plant (WTP). In this case the parameters of interest are biological oxygen demand (BOD) and disolved oxygen demand (DO) both of which decay over time as well as being diluted on entering the river channel.

The model has options to simulate several water quality parameters which are shown in the menu from the screenshot in Figure 5.2.

Figure 5.2: Water Quality Parameters Available for Simulation in HYDRO-1D



There are several WTP in the model region and the model has potential to assess the impact of effluents entering the rivers from each of these discharge points. The options to assess the BOD and DO levels along the river reaches bring further benefits to assess the level of treatment required from these treatment facilities. Preliminary testing on BOD and DO levels has been carried out to check the performance of the model. However, data collection including monitoring of flows and water quality determinands are pre-requisite to obtain the maximum benefit of the water quality model developed for this region.

5.5 Forecasting Demand for Municipal and Rural Water Supplies

5.5.1 Approach

The approach to demand forecasting is given in the Guidance Note – Forecasting Demands for Municipal and Rural Water Supplies. The guidance note presents a simple procedure based on breaking the demand down into the following components:

- Household consumption, including consumption for both in the house and outside for car washing, yard cleaning and garden watering.
- General non-household consumption (institutions, commercial premises, small and medium industries)
- Major industries with large water demands
- Unaccounted for water (UfW), which includes physical losses from the distribution system, legitimate unmeasured use, illegal consumption and meter error.

The system could be made more sophisticated as more data become available, but at present demand forecasting is likely to be limited by data availability and any forecasts must be regarded as indicative projections that will need to be updated in the future. In fact there is always an element of uncertainty in demand forecasting and the growth in demand always needs to be monitored carefully and forecasts reviewed and improved as necessary.

The Guidance Note also includes assessments of wastewater returns.

5.5.2 Per Capita Demands

Per capita demands have been assessed assuming that a programme of demand management is implemented. The derivation of the figures used is described in the Guidance Note. Household demand, non-household demand and Unaccounted for Water have all been expressed in litres per capita per day (lpcd).

The figures are summarised in the table below.

It is emphasised that these are broad assessments of a reasonable level of demand and need to be re-assessed for individual schemes. They provide a reasonable basis for a preliminary assessment of demands and the investments that will be needed in water supply and wastewater systems.

Table 5.2 : Provisional Forecasts of Per Capita Demands

Baghdad

Category	Average daily demand (lpcd)	Peak daily demand (lpcd)
Households	160	200
Non-households (See Note 1)	80	88
UfW	80	80
Total	320	368

Other towns

Category	Average daily demand (lpcd)	Peak daily demand (lpcd)
Households	160	200
Non-households (See Note 1)	40	44
UfW	67	67
Total	267	311

Rural communities with piped distribution

Category	Average daily demand (lpcd)	Peak daily demand (lpcd)
Households	120	150
Non-households (See Note 1)	12	13
UfW	44	44
Total	176	207

Note : 1. Specific large industries and residential institutions to be added separately to the overall allowance

5.5.3 Preliminary Demand Forecasts

Preliminary overall estimates of potable water demand throughout Iraq are presented Tables 5.3 (average daily demand) and 5.4 (peak daily demand).

These are based on 3% p.a. increase in population and the overall gross per capita demands above.

5.5.4 Preliminary Water Balances

Once an assessment of water demands and the methods of disposal of wastewater has been completed a water balance for the potable and industrial water supplies for each district can be prepared. This water balance will show transfers from one part of the river system to another and also movements between surface water and groundwater. An example for Thi Qar governorate is given in Figure 5.3.

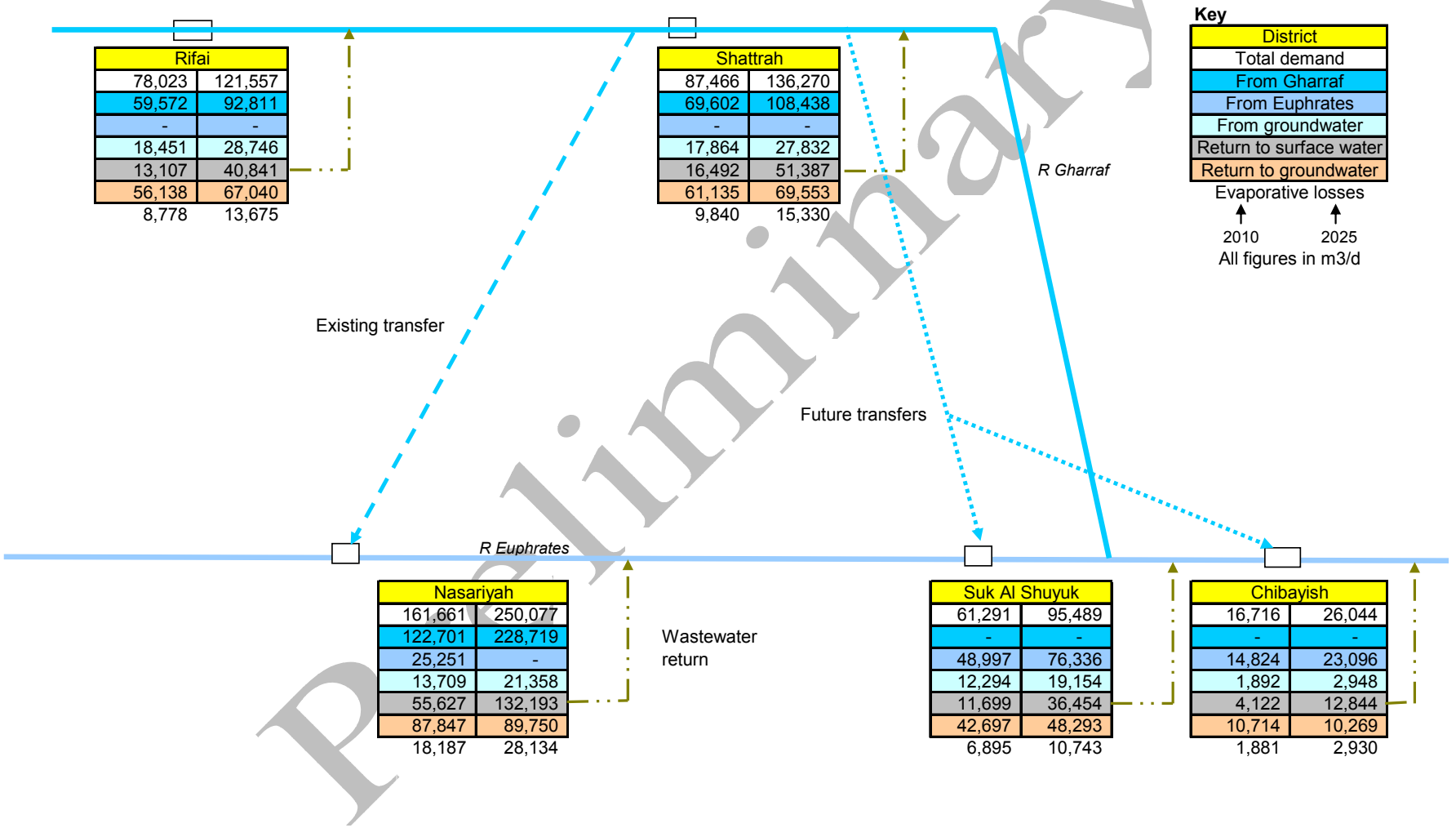
Table 5.3: Average Daily Potable Water Demands - Preliminary Forecasts for Each Governorate

Governorate	Average Water Demand (m3/d)														
	2005			2010			2015			2020			2025		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Nineveh	429,104	180,183	609,287	497,449	208,882	706,331	576,680	242,151	818,831	668,530	280,719	949,249	775,009	325,431	1,100,440
Al-Tameem	163,446	47,158	210,605	189,479	54,669	244,149	219,658	63,377	283,035	254,644	73,471	328,115	295,202	85,173	380,376
Diala	162,376	150,103	312,479	188,238	174,011	362,249	218,219	201,727	419,946	252,976	233,856	486,832	293,268	271,104	564,372
Al-Anbar	189,943	115,675	305,617	220,195	134,099	354,294	255,267	155,457	410,724	295,924	180,218	476,142	343,057	208,922	551,979
Baghdad	1,895,679	145,509	2,041,187	2,197,611	168,684	2,366,296	2,547,634	195,551	2,743,185	2,953,406	226,698	3,180,104	3,423,807	262,805	3,686,612
Babylon	194,014	142,892	336,906	224,915	165,651	390,566	260,739	192,035	452,773	302,268	222,621	524,888	350,411	258,078	608,489
Kerbela	141,023	49,721	190,745	163,485	57,641	221,125	189,523	66,821	256,345	219,710	77,464	297,174	254,704	89,802	344,506
Wasit	140,146	83,693	223,839	162,468	97,023	259,491	188,345	112,476	300,821	218,343	130,390	348,734	253,120	151,158	404,278
Salah Al-Deen	139,486	110,974	250,459	161,702	128,649	290,351	187,457	149,139	336,596	217,314	172,893	390,207	251,927	200,431	452,357
Al-Najaf	185,636	54,997	240,634	215,203	63,757	278,960	249,480	73,912	323,392	289,216	85,684	374,899	335,280	99,331	434,611
Al-Qadisiya	130,967	78,932	209,899	151,826	91,504	243,330	176,008	106,078	282,087	204,042	122,974	327,016	236,540	142,560	379,101
Al-Muthanna	67,528	56,096	123,625	78,284	65,031	143,315	90,752	75,389	166,141	105,207	87,396	192,603	121,963	101,316	223,280
Thi-Qar	236,158	111,248	347,406	273,772	128,967	402,739	317,377	149,508	466,884	367,926	173,321	541,247	426,528	200,926	627,454
Maysan	136,837	48,094	184,931	158,632	55,754	214,386	183,898	64,634	248,532	213,188	74,928	288,116	247,143	86,862	334,006
Basrah	389,231	69,337	458,568	451,225	80,381	531,606	523,094	93,183	616,277	606,409	108,025	714,434	702,994	125,231	828,225
Duhouk	95,596	22,593	118,189	110,822	26,191	137,013	128,473	30,363	158,836	148,935	35,199	184,134	172,656	40,805	213,462
Arbil	292,380	59,629	352,009	338,948	69,126	408,075	392,934	80,136	473,070	455,518	92,900	548,418	528,071	107,696	635,767
Sulaimaniya	332,857	91,590	424,447	385,872	106,178	492,050	447,332	123,089	570,421	518,580	142,694	661,274	601,177	165,422	766,598
Total	5,322,406	1,618,424	6,940,830	6,170,128	1,876,197	8,046,325	7,152,869	2,175,026	9,327,896	8,292,136	2,521,452	10,813,588	9,612,858	2,923,054	12,535,912

Table 5.4: Peak Daily Potable Water Demands - Preliminary Forecasts for Each Governorate

Governorate	Peak Day Water Demand (m3/d)														
	2005			2010			2015			2020			2025		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Nineveh	499,818	211,920	711,737	579,426	245,673	825,099	671,713	284,803	956,516	778,700	330,164	1,108,864	902,726	382,751	1,285,477
Al-Tameem	190,381	55,465	245,846	220,704	64,299	285,003	255,857	74,540	330,397	296,608	86,412	383,020	343,850	100,175	444,025
Diala	189,134	176,542	365,676	219,258	204,661	423,919	254,180	237,258	491,438	294,665	275,047	569,712	341,597	318,855	660,452
Al-Anbar	221,244	136,050	357,293	256,482	157,719	414,201	297,333	182,839	480,173	344,691	211,961	556,652	399,591	245,721	645,312
Baghdad	2,180,031	171,138	2,351,169	2,527,253	198,396	2,725,649	2,929,779	229,995	3,159,774	3,396,417	266,627	3,663,044	3,937,378	309,094	4,246,472
Babylon	225,986	168,060	394,047	261,980	194,828	456,808	303,707	225,859	529,566	352,079	261,832	613,912	408,157	303,535	711,692
Kerbela	164,263	58,479	222,742	190,426	67,793	258,219	220,756	78,591	299,347	255,916	91,108	347,025	296,677	105,620	402,297
Wasit	163,241	98,434	261,675	189,242	114,112	303,353	219,383	132,287	351,670	254,325	153,357	407,682	294,832	177,783	472,615
Salah Al-Deen	162,472	130,520	292,992	188,350	151,309	339,658	218,349	175,408	393,757	253,126	203,346	456,472	293,443	235,734	529,176
Al-Najaf	216,228	64,684	280,912	250,668	74,987	325,655	290,593	86,930	377,523	336,876	100,776	437,652	390,532	116,827	507,359
Al-Qadisiya	152,549	92,835	245,384	176,846	107,621	284,468	205,013	124,763	329,776	237,667	144,634	382,301	275,521	167,670	443,191
Al-Muthanna	78,656	65,977	144,633	91,184	76,485	167,670	105,708	88,668	194,375	122,544	102,790	225,334	142,062	119,162	261,224
Thi-Qar	275,075	130,843	405,918	318,888	151,683	470,570	369,678	175,842	545,520	428,558	203,849	632,407	496,817	236,316	733,133
Maysan	159,387	56,565	215,952	184,773	65,574	250,347	214,203	76,018	290,221	248,320	88,126	336,446	287,871	102,162	390,033
Basrah	453,374	81,550	534,924	525,585	94,539	620,124	609,297	109,596	718,893	706,342	127,052	833,394	818,844	147,288	966,132
Duhouk	111,349	26,572	137,922	129,084	30,805	159,889	149,644	35,711	185,355	173,479	41,399	214,877	201,109	47,993	249,102
Arbil	340,562	70,132	410,694	394,805	81,302	476,107	457,687	94,251	551,938	530,585	109,263	639,848	615,094	126,665	741,759
Sulaimaniya	387,710	107,722	495,432	449,462	124,880	574,342	521,050	144,770	665,819	604,039	167,828	771,867	700,247	194,558	894,805
Total	6,171,462	1,903,487	8,074,950	7,154,416	2,206,663	9,361,080	8,293,929	2,558,128	10,852,057	9,614,937	2,965,571	12,580,508	11,146,347	3,437,910	14,584,257

Figure 5.3: Preliminary Water Balance for Thi Qar Governorate



5.6 Hydropower Potential

The installed capacity, annual energy generation, annual hours of generation, static head values and expected capital costs have been obtained for the 7 existing and 68 potential hydropower stations in Iraq from the Ministry of Energy. The data has been used to develop a workbook that gives an indication of some of the possible scenarios for hydropower development in Iraq from now until 2030.

The scheme summary workbook should be used to get an impression of the potential for hydropower development in Iraq as well as approximate power and energy production that could be obtained at different sites, and the water required to produce this. The workbook should be updated with more accurate data as it becomes available, for example as pre-feasibility and feasibility studies of these potential schemes are carried out. This will then allow the scenarios to be updated and more accurate conclusions can then be reached

Table 5.5: Preliminary Forecast Hydropower Energy and Power - Possible Scenarios

	Additional Energy Demand (GWh)	% of Total Energy Demand which could be met by Hydropower	Additional Hydropower Energy Demand (GWh)	Potential Schemes to be Constructed	Energy (GWh/yr)
2005 - 2010	22,444	20%	**4,489**	Bekhme	4,800
2010 - 2015	31,479	18%	**5,666**	Samarra-1	200
				Samarra-2	1,070
				Nineveh-1	900
				Nineveh-2	90
				Rawa	830
				Qaiyara	1,380
				Qaiyara Diversion	1,230
2015 - 2020	44,152	16%	**7,064**	Makhul	1,480
				Al-Baghdadi	1,250
				Assur	1,350
				Assur Diversion	1,220
				Altun Kupri	1,200
				Kili	207
2020 - 2025	61,925	14%	**8,669**	Abassi	610
				Tikrit	1,990
				Tikrit-1	870
				Tikrit-2	930
				Daur	570
				Badush-1	497
				Badush-2	219
				Khamam	720
				Nimrud	230
				Safiya	510
				Quwair- 1	290
				Quwair- 2	290
				Taq-taq	980
2025 - 2030	86,853	12%	**10,422**	Qala-Diza-1	700
				Qala-Diza-2	500
				Quwair- 3	370
				Amadiya	1,780
				Rashawa	980
				Bawn	620
				Mandawa	2,240
				Halwan	1,020
				Taili with Murak Hyd	606
				Tongar	450
				Qara Teppe	730
				Qara Teppe-2	420

	Additional Power Demand (MW)	% of Total Power Demand which could be met by Hydropower	Additional Hydropower Power Demand (MW)	Potential Schemes	Power (MW)
2005 - 2010	3,061	20%	**612**	Bekhme	1,500
2010 - 2015	4,293	18%	**773**	Samarra-1	56
				Samarra-2	300
				Nineveh-1	300
				Nineveh-2	20
				Rawa	330
				Qaiyara	420
				Qaiyara Divers	400
2015 - 2020	6,021	16%	**963**	Makhul	500
				Al-Baghdadi	400
				Assur	415
				Assur Diversio	400
				Altun Kupri	300
				Kili	80
2020 - 2025	8,444	14%	**1,182**	Abassi	200
				Tikrit	600
				Tikrit-1	300
				Tikrit-2	280
				Daur	170
				Badush-1	154
				Badush-2	38
				Khamam	240
				Nimrud	80
				Safiya	170
				Quwair- 1	85
				Quwair- 2	85
				Taq-taq	400
2025 - 2030	11,843	12%	**1,421**	Qala-Diza-1	300
				Qala-Diza-2	165
				Quwair- 3	110
				Amadiya	900
				Rashawa	550
				Bawn	220
				Mandawa	480
				Halwan	200
				Taili with Mura	300
				Tongar	155
				Qara Teppe	245
				Qara Teppe-2	140

Note: Annual energy production is factor determining plants to be implemented, not installed capacity.

6 Institutional Assessment

6.1 Introduction

The main purpose of the SWRLI project is to establish the permanent system for long term strategic water and land resources planning and management in Iraq consisting of a reliable planning framework backed by strong institutional arrangements. The present chapter reviews the institutional situation as it was throughout Phase 1 and attempts to draw lessons to take forward to the design of Phase 2.

A feature of the institutional background at the start of Phase 1 was a tendency for government staff to operate within a vertical communication structure (silos) with limited horizontal communication between directorates of the same ministry or between one ministry and another. Effective implementation of the concepts of integrated planning requires a high degree of sharing of information across departmental and ministerial divides. During Phase 1 many efforts have been made to encourage a change of attitudes, but such entrenched habits take time to break down.

6.2 Inter-ministerial Coordination

MoWR initiated a Steering Committee for SWLRI which held four meetings during Phase 1. Eleven ministries are represented on the Steering Committee bringing together all the key government stakeholders.

Table 6.1: Participating Ministries

Ministry of Water Resources
Ministry of Agriculture
Ministry of Muncipalities and Public Works
Ministry of Planning and Development Cooperation
Ministry of Energy
Ministry of Environment
Ministry of Transport and Industry
Ministry of Trade
Kurdistan Regional Ministry of Water and Agriculture, Erbil
Kurdistan Regional Ministry of Water and Agriculture, Sulymaniyah
Baghdad Municipality

Notes:

1 Kurdistan Regional Ministries merged during Phase 1

2 Ministry of Planning and Baghdad Municipality joined the Steering Committee from April 2006.

In setting up the Phase 1 Work Plan it was agreed that the Steering Committee membership should be defined in terms of the ministries that comprise it, not in terms of named individuals. Each Minister should be free to attend Steering Committee meetings in person, or to delegate any official to represent the ministry, and the level of representation might vary from one meeting to another depending on the agenda. It was further agreed however that ministries would need to assign officials of suitable status

and experience, empowered not only to guide the consultants in the work, but also to ensure that liaison, data collection, decision-making and capacity-building took place efficiently and on schedule.

The Phase 1 Work Plan foresaw the need for each ministry to provide additional staff time to help with the finding and collection of data, and in August 2005 each ministry nominated a 'Data Collection Leader' to act as the focal point for liaison with the consultants and with responsibility for ensuring that the ministry provided all requested data in a timely fashion. The role of these Data Collection Leaders is discussed in Section 3.3.

In practice the Steering Committee meetings tended to be attended by the Data Collection Leaders, rarely were more senior ministry representatives present. This meant that the Steering Committee did not provide as much guidance as was hoped for.

6.3 The Role and Function of the SWLRI Unit

The Phase 1 Scope of Work envisaged that:

'The Ministry of Water Resources would be the main government contact point for the consultants, and would take a major role in co-ordinating the activities of the others, directly and through the Steering Committee. This will require MoWR to set up and staff a small office to coordinate the work, to act as secretariat to the Committee, and to provide office space for the consultants' liaison staff (the project can provide equipment for this office). MoWR would also play a major role in collecting data for all three databases, in setting the comparison criteria and in considering cross-border issues.'

In collaboration with ARDI, MoWR established the SWLRI Unit. The unit is attached to the General Directorate of Water Resources and located in Baghdad. Other key branches of MoWR, such as the Hydrology Studies Centre and the GIS and Remote Sensing Centre, are based at the same location. Four caravans, with a total area of 130 m^2, were provided for the new unit and the office was fully furnished and equipped with the necessary IT facilities. The new facilities were occupied by January 2006.

The complement of MoWR staff forming the SWLRI Unit was built up to two Senior Chief Engineers, one Expert Agronomist, two Irrigation Engineers, and two IT engineers. During Phase 1 the SWLRI Unit was supported by the consultants to help to build capacity among the MoWR staff who were transferred to the unit from other branches of the Ministry. ARDI funded four positions in the SWLRI Unit: a part time water resources planner, two engineers and an IT support position. The ARDI water resources planner acted as the key liaison officer between the SWLRI Unit and the consultants team, who were unable to work directly with the SWLRI Unit in Baghdad for security reasons.

The SWLRI Unit acted as the focal point for liaison with the other stakeholder ministries for setting up Steering Committee meetings and for monitoring the progress of the data collection programme. The ARDI personnel within the Unit undertook most of this work particularly in the early months. Later in Phase 1, with the deterioration in the security situation, the ARDI water resources planner was unable to work in Baghdad with the SWLRI Unit but continued to act remotely. This change reduced the opportunity for capacity building in some areas. The SWLRI Unit – in its capacity as a secretariat to the Steering Committee – would normally be expected to arrange meetings, determine the agenda, and prepare and circulate the minutes. In practice, ARDI's independence and impartiality was used to facilitate quick and decisive administrative decisions, in order to maintain the momentum of the project.

During the meeting of the Steering Committee in July 2006, a number of recommendations were made for the development and strengthening of the SWLRI Unit. The consensus views that emerged from that workshop covered four key areas and are summarised below in Box 6.1.

BOX 6.1 Role and Function of the SWLRI Unit

(a) Authority:

- Appropriate authority should be given to SLWRI Unit and units and/or committees in other ministries
- Adequate financial resources should be budgeted

(b) Human resources:

- Recruit staff with specialist skills to fill skill gaps and strengthen capacity
- Develop a cross-ministerial capacity building programme (eg to strengthen planning requirements at technical level, as well as at a higher level with exposure to master planning processes)
- Obtain technical assistance through secondments of specialists from academic and research organisations

(c) Mechanism for cross-Ministerial cooperation

- Member Ministries should contribute to specialists to broaden skills within SWLRI unit
- Within each Ministry there should be a special planning unit or committee which coordinates activities directly with the MoWR SWLRI Unit.
- Establish cross-ministerial secondment mechanisms

(d) Logistics (for all Ministries)

- Office accommodation
- Transport
- Equipment: computers and software

As discussed in Chapter 3 ministries nominated a ‘data collection leader’ as the key person for contact on all matters to do with the data collection activities. At each data collection and Steering Committee meeting the data collection leaders were put on the spot to explain the progress of their ministry and to provide target dates for meeting specific data requests. In the case of the MoWR no data collection leader was nominated – the role was assumed to be filled by personnel in the SWLRI Unit. This was perhaps unfortunate because much of the data being sought was actually required from the MoWR, sometimes from governorate offices rather than the centre, and was often difficult to obtain. A nominated member of the SWLRI Unit could have been put on the spot in the same way as the other ministry data collection leaders about the lack of progress. This might have been fairer on the other ministries and also might have improved the performance of the MoWR (it appeared successful with many of the other ministries when they fell behind on their commitments).

6.4 Training and Capacity Building

Capacity building included a number of training courses and two study visits:

Table 6.2: SWLRI Phase 1 Training Courses

Course Subject	Nr and location	Attendees
Claromentis user training	2 (Erbil)	All participating ministries
Claromentis Administrator	1	MoWR
Introduction to GIS	2 (Erbil)	All participating ministries
GIS for asset management	1 (Basra)	All participating ministries
GIS and remote sensing advanced users	1 (Basra)	All participating ministries
Gauging station upgrade and use of ADCP for flow measurement	1 (Dohuk)	MoWR, Kurdish Regional Ministry of Water
6-week study visit	1 (Cambridge, UK)	MoWR
1-week study visit	1 (Cambridge, UK)	MoWR

In addition to the formal courses listed above, Phase 1 included some 8 data collection meetings and two GIS cluster meetings. These were attended by delegates from all participating ministries and have encouraged networking among professionals in the water sector.

A feature of the GIS capacity building efforts was the deliberate decision to have the MoWR GIS Unit take the lead role with the consultants assisting. Given the high level of expertise available within the MoWR GIS Unit this was seen as the best way to achieve a sustainable GIS capability and to deliver the type of products most in demand for the overall strategic planning effort.

The 6-week study visit by a team of four MoWR staff to the ARDI consultant's office in Cambridge UK, focussed on data quality control and capacity building on aspects of the planning process. The Iraq MCDM was developed during this period. During the succeeding Steering Committee Meeting (in July 2006), it was evident that the MoWR staff were enthusiastically introducing colleagues to the techniques. This concept of training of trainers is one area that should be given more attention in Phase 2.

Taking account of the timing of the visit in relation to the overall SWLRI programme, and the seniority of the participants, the objectives were set as:

- Work on completing and quality controlling baseline data
- Development of preliminary intervention packages
- Development of needs data set
- Practical demonstration of planning techniques
- Provide opportunities for professional development

The following table makes an assessment of the achievements of the six week study visit.

Objective	Status	Comment
Work on controlling and completing data sets	Partially achieved	Use of some of the planning tools highlighted further gaps in data. The team managed to sort out a number of queries about data and to chase up data release with colleagues in Baghdad
Development of needs data sets	Little progress	The delay in the Baghdad data meeting from 5 June to 19 June meant that policy/ likely direction of development information was not available during the visit
Practical demonstration of planning techniques - multi-criterion analysis: development of a multi-criterion decision model (MCDM) for SWLRI	Largely achieved	Considerable progress was made. The visitors have prepared a presentation on this process for delivery at the Steering Committee meeting
Practical demonstration of planning techniques – other than MCA	Achieved	Presentations, case studies and workshop discussions were used by all the specialists to demonstrate planning techniques in their various fields of expertise
Development of preliminary intervention package	Partially achieved	The MoWR web site gives over 250 possible projects. Typical examples from this list have been evaluated by the team using the MCDM
Provide opportunities for professional development	Achieved	Quite a number of the activities took the visitors outside their normal professional experience and introduced them to new subjects. Others provided exposure to the latest developments in fields with which they were already familiar

The 1-week study visit focussed on transboundary water management looking at practical experience from other river basins, and in particular at the implications of the European Water Framework Directive that might come to apply to the Tigris-Euphrates basin if Turkey continues a path towards eventual membership of the EU.

A separate report was prepared for each of the courses listed in Table 6.1 and minutes of meetings were prepared and circulated for each of the data and GIS cluster meetings.

7 Phase 1 Achievements and Phase 2 Proposals

7.1 Introduction

When MoWR recognised that a new effort was needed to develop an updated integrated strategy plan for developing and managing its water resources a two-phase approach to the task was proposed taking around 5-6 years. The concept was further developed early in 2005 culminating in a scope of work discussed with the MoWR and other Iraqi ministries in Amman from 7-9 June 2005. It was agreed that Phase 1 would be completed in 14 months and would be led mainly by consultants from ARDI with extensive MoWR oversight and involvement, while Phase 2 would be led mainly by MoWR.

The scope of work for Phase 1 included 'the careful formulation of proposals for Phase 2'. It was intended that initial suggestions would be drawn up by the central study team and then circulated to interested stakeholders as a draft for discussion. It was seen as essential that MoWR and other ministries should be comfortable with the final recommendations. This process was started at the July 2006 Steering Committee meeting when a workshop session was held on the future direction for the strategy development. After that workshop the consultants prepared a draft intended for a further round of consultation. The curtailment of the Phase 1 consultancy has meant that the Phase 2 proposals put forward here have not yet had the benefit of the intended further consultation.

7.2 Phase 1 Achievements

Phase 1, running from June 2005 to September 2006, largely focused on Stage A – data collection (Figure 1.1), but from May 2006 a start was made on Stage B – evolution of the strategy plan.

An extensive data collection exercise was undertaken with the assistance of 11 ministries with an interest in water and land resources. The project established a web-based collaboration system and by the end of Phase 1 over 13,600 items had been uploaded and were available as a shared resource for the planning team. Organising and checking this volume of data continued throughout Phase 1, and will need to continue in the future, leading to the formation of databases of essential information for planning.

The ARDI consultants have been developing models of the water management system infrastructure to allow alternative future scenarios of water usage country-wide to be compared. Other models and analytical tools to support the planning process have been developed, with the scope for further tools outlined.

A start was made on the preliminary assessment of potential projects to demonstrate the use of the various models and analytical tools within the recommended planning approach. Data constraints were identified in most cases and often the tools were demonstrated with data that was over 20 years old (usually deriving from the General Scheme studies by the Russians). The testing highlighted areas where more work on data collection and processing would be needed in Phase 2.

In addition to the contents of the SWLRI toolkit referred to above, Phase 1 has seen the issue of training and study visit reports, a data management report, the Inception and Interim project reports, minutes of Steering Committee meetings, GIS Cluster meetings, and data collection meetings.

The Claromentis system hardware and software has been handed over to MoWR. This includes the data repository and the toolkit, together with the project reports, minutes, presentations etc associated with project meetings.

7.3 Phase 2 Scope of Work

As part of the July 2006 Steering Committee Meeting, a preliminary workshop was held to discuss the nature and scope of Phase 2. The consensus views that emerged from that workshop are summarised below in Box 7.1.

BOX 7.1 Aims of Phase 2

Overarching Goal
- The optimal use of all water and land resources for all sectors

Primary Outputs
- A framework for water and land resources strategy for Iraq and preparation of a master plan
- Determine and adopt internationally accepted conventions for negotiation with riparian countries about access to, and sharing of, common resources.
- Decision-making on priorities for implementation of projects from different sectors.

Inputs
- Greater cross-ministerial cooperation
- Emphasis on training (esp training of trainers) and capacity building
- All data gaps filled in, obtaining firm water resources planning data from other countries (esp Turkey)

Donor Coordination
- Ensure coordination of investments in water and land resources between donors.

Role of Consultant
- To provide support and technical assistance to Iraqi staff

Duration: 3 to 5 years

Source of Funding:
- Government of Iraq
- International donors

The consultants have taken these ideas and drafted a Phase 2 Scope of Work document. The document has been prepared in the knowledge that it should be a proposal that the MoWR could take forward into discussions with potential donors.

The proposals cover further strengthening of the fundamental building blocks for a successful strategy development process: data issues, modelling enhancements, more capacity building, greater collaboration between ministries and the inclusion of other stakeholders. A government review of legal and institutional arrangements has also been identified as an essential precursor to achieving a fully fledged planning organisation for the water sector.

The Phase 2 Work Plan is contained in Volume 7 and is bound separately so that it can be presented to potential donors.

During the July 2006 meeting, a number of suggestions were also made concerning the future role of the Steering Committee, which were to: (a) extend participation of the Steering Committee beyond dominant role of data collection planning process into planning, design and decision-making processes; (b) establish decision-making processes to ensure transparent selection of priority opportunities for investment; and (c) establish and revise policies (for which functions it was recognised that higher level representation would be required on the Steering Committee).

Appendix A Site Map for Claromentis

This appendix provides a 'site map' of the planner's toolkit, it does not cover the contents of the data repository.

	File Name	Comment
Planning: MCA, Planning General, Economics		
Data		
Review of data		
What data is needed in future		
Data collection forms		
Manuals		
Guidance Notes		
MCA	Introductory Explan of MCDA_FINAL.pdf	
Planning processes	Planning process_FINAL.pdf	
Introduction to CBA	Introduction to CBA_FINAL.pdf	
Calculation workbooks		
MCA	scoring rules as spreadsheets - PJH V4.xls	Proforma for developing rules
MCA	value trees PJH V1a.xls	Value trees for developing weightings
MCA	MCDM table example V5.xls	Format for recording scores and calculating ranking
CBA	AYS financial arable farm budget from MJS+E Gharraf.xls	Financial Farm Budget demonstration calculation for arable farming
		Financial Farm Budget demonstration calculation for livestock farming
	AYS economic arable farm budget from MJS+E Gharraf.xls	Economic Farm Budget demonstration calculation for arable farming
		Economic Farm Budget demonstration calculation for livestock farming
Map products		
Models		
Reference Library		
References		
Useful web links		
Training materials		
	استحقاقات المؤثرات المتداخلة.ppt	MCA presentation in Arabic
Presentation material from visits		

	File Name	Comment
	Presentation introducing MCA_Mike Snell.ppt	
	Steering Committee Presentation on MCA development.ppt	MCA presentation in English
JFP	Donor cycle Rev 0.ppt	
JFP	Project cycle Rev 0.ppt	
JFP	Promoters roles Rev 0.ppt	
JFP	Risks Rev 0.ppt	
JFP	RACI rev 0.xls	
S Murphy	Iraq Data e.g.xls	Basin wide economic analysis
	Cost benefit for SWLRI.ppt	
Best Practice Case Studies		

	File Name	Comment
Agriculture and Irrigation		
Data		
Review of data	Agricultural data received.doc	Data received from the Ministry of Agriculture
What data is needed in future	Additional Information on Irrigation.doc	Additional data required for irrigation schemes
Data collection forms	MCA Parameters for Irrigation Projects.doc	Data required to analyse irrigation projects using MCA
	Agricultural Prices_Costs-Irrigated areas.xls	
	Agricultural Prices_Costs-Rain fed areas.xls	
	Agricultural Prices_Income.xls	
	Agricultural Prices_Subsidies.xls	
	Agricultural Production.xls	
	Agri-processing plants.xls	
	Cost of Production by Crop-Irrigated Areas.xls	
	Cost of Production by Crop-Rainfed Areas.xls	
	Cropped Area_1-Rain Fed Areas.xls	
	Cropped Area_2-Irrigated Areas.xls	
	Cropping Calender.xls	
	Gross Irrigation Rates.xls	
	Harvested Area by Crop-Irrigated Areas.xls	
	Harvested Area by Crop-Rainfed Areas.xls	
	Land Use_1.xls	

	File Name	Comment
	Land Use_2-Rain Fed Areas.xls	
	Land Use_3-Irrigation Areas.xls	
	Livestock & Poultry.xls	
	Monthly gross Irrigation Rates-Central Zone.xls	
	Monthly gross Irrigation Rates-Northern Zone_sub A.xls	
	Monthly gross Irrigation Rates-Northern Zone_sub B.xls	
	Monthly gross Irrigation Rates-Northern Zone_sub C.xls	
	Monthly gross Irrigation Rates-Southern Zone.xls	
	Monthly gross Irrigation Rates-Southern Zone_sub A.xls	
	Ownership.xls	
	Reclamative Conditions-Irrigated Areas.xls	
	Sown Area by Crop-Irrigated Areas.xls	
	Sown Area by Crop-Rainfed Areas.xls	
	Tree numbers.xls	
	Use of Fertilizers.xls	
	Value of Animal Products.xls	
	Value of Production by Crop-Irrigated Areas.xls	
	Value of Production by Crop-Rainfed Areas.xls	
	Yield+Output Animal Products.xls	
	Yield+Output Summer Crop-Irrigated Areas.xls	
	Yield+Output Summer Crop-Rainfed Areas.xls	
	Yield+Output Winter Crop-Irrigated Areas.xls	
	Yield+Output Winter Crop-Rainfed Areas.xls	
	Main Drains.xls	
	Pumping stations.xls	
	Regulating structures.xls	
	Small pumping plants.xls	
Manuals		
	CropWat	FAO document
Guidance Notes		
Irrigation Water	Irrigation Water Req_Final.pdf	

	File Name	Comment
Requirements		
Calculation workbooks		
Water requirements	Rice Diversion Requirements.xls	
	Non-rice Diversion Requirements.xls	
	GS_Viii_Bk2 Table 7-1 Irrig Sys (Mr Satar 05-07-06).xls	Current status of irrigation schemes
	Zonal Net irrig req.xls	Net water requirement by zone and by crop
	Crop Yields in 18 Regions, Irrigated and Rainfed (1976-1977).xls	
	Monthly gross Irrigation Rates-Central Zone.xls	
	Monthly gross Irrigation Rates-Northern Zone_sub A.xls	
	Monthly gross Irrigation Rates-Northern Zone_sub B.xls	
	Monthly gross Irrigation Rates-Northern Zone_sub C.xls	
	Monthly gross Irrigation Rates-Southern Zone.xls	
	Monthly gross Irrigation Rates-Southern Zone_sub A.xls	
	Monthly Net Irrigation Rates-Central Zone.xls	
	Monthly Net Irrigation Rates-Northern Zone_sub A.xls	
	Monthly Net Irrigation Rates-Northern Zone_sub B.xls	
	Monthly Net Irrigation Rates-Northern Zone_sub C.xls	
	Monthly Net Irrigation Rates-Southern Zone.xls	
	Monthly Net Irrigation Rates-Southern Zone_sub A.xls	
	Yield+Output Summer Crop-Irrigated Areas.xls	
	Yield+Output Summer Crop-Irrigated Areasnew.xls	
Map products		
Irrigation schemes	Irrigation_Areas.dbf Irrigation_Areas.ldb Irrigation_Areas.mdb Irrigation_Areas.prj Irrigation_Areas.sbn Irrigation_Areas.sbx	Template for completion by MoWR GIS centre with MoA

	File Name	Comment
	Irrigation_Areas.shp Irrigation_Areas.shx	
Russian report climate zones		
Models		
Crop irrigation requirements	CropWat v4	FAO software
Reference Library		
References		
Useful web links		
	http://www.fao.org/AG/agl/aglw/cropwat.stm	Crop water requirements
	http://www.iwmi.cgiar.org/	International Water Management Institute
Training materials		
Presentation material from visits		
Best Practice Case Studies		

	File Name	Comment
Water Supply, Sanitation, Water Pollution		
Data		
Review of data	N Morris	
What data is needed in future		
	Industrial flows and Loads AP.xls	Template to be updated
Data collection forms		
Manuals		
HYDRO-1D WQ	HYDRO-1D Manual-v2.doc	
Guidance Notes		
Demand Forecast	Demand Forecasting_BLB formatted_v2.doc	
Demand Management	Demand Management_BLB formatted.doc	
	WS output_BLB formatted_v2.doc	
Calculation workbooks		
Water requirements	Thi Qar Forecasts.xls	

	File Name	Comment
	Erbil Forecasts.xls	
	Water_demands.xls	
APaskins	Example discharges.xls	
Map products		
Models		
	HYDRO-1D Baghdad pilot	
Reference Library		
References		
A Paskins	List of useful refernece Books.doc	
Useful web links		
A Paskins	List of useful Links.doc	
Training materials		
Presentation material from visits		
A Paskins	SWLRI Industrial Pollution Control.ppt	
N Morris	Supply Demand Balance Summary.ppt	
N Morris	Demand Management.ppt	
Best Practice Case Studies		
N Morris	Oman_Water_MP.ppt	

	File Name	Comment
Groundwater		
Data		
Review of data	Data register.xls	Review of groundwater data available on Claromentis
What data is needed in future	Groundwater data needs for SC meeting.ppt	Presentation for Steering Committee (June 2006) meeting detailing what data we have and what data is still needed.
Data collection forms		
Manuals		
Guidance Notes		
	Appendix E_ Hydrogeology of Iraq.doc	Overview of the hydrolgeology of Iraq and possibilities for groundwater exploitation in Iraq.

	File Name	Comment
Calculation workbooks		
Map products		
	MoWR_Wells map_letter 1682.doc	Map of the hydrogeology of Iraq
Models		
Reference Library		
References		
	FAO study of northern Iraq by remote sensing.pdf	
	Various	FAO reports on well drilling in Northern Iraq.
	Hydrogeology Chapter from Dr Saad book.pdf	Chapter from recenty published book "Geology of Iraq".
	Mosul gw model.pdf	Paper on the problem of high groundwater elevations and its impact on Monsul City, Iraq.
Useful web links		
Training materials		
Presentation material from visits		
CRCJ	Groundwater resources development.ppt	Presentation on groundwater resources management and development .
Best Practice Case Studies		
	Abu Dhabi Emirate Case Study.ppt	Groundwater Management Case Study from UAE.
	Groundwater in the UK2.ppt	Presentation on how groundwater is managed in the UK.

	File Name	Comment
Environment		
Data		
Review of data		
What data is needed in future		
	Fish and fisheries Information needs.doc	
Data collection forms		
Manuals		
Guidance Notes		

	File Name	Comment
	Fish and fisheries in Iraq.doc	
Calculation workbooks		
	Fishes of Iraq_7.xls	Database of information from several sources
	Iraq_Calendar of Events.xls	Diary of ecologically significant events eg migration periods
Map products		
Models		
Reference Library		
References		
	Marshlands report Iraq foundation.pdf	
	UNEP mesopotamia.pdf	
	UNEPalhawizeh1.pdf	
	Science Article 02 2005.pdf	
	AQUASTAT - FAO's Information System on Water and Agriculture.htm	Fish and fisheries
	Endemic.htm	Fish
	Fish Bibliography_Iraq.htm	Fish
	Fish Checklists_Iraq.htm	Fish
	FishBase_Fishes of Iraq.htm	Fish
	FishBase_Fwater fish in Iraq.htm	Fish
	Fishes of Iraq_FishBase.xls	Fish
	RegionSpeciesList.htm	Fish
	Threatened fishes.htm	Fish
	Brian Coad's Ichthyology Site.htm	Fish
Useful web links		
Training materials		
Phil LeGouais	Case Study Material.doc	
Presentation material from visits		
PLG	EA Presentation.ppt	Environmental assessment
Best Practice Case Studies		
	Calendar of events_Lough Neagh_6_12_Jul_05_UF.xls	Example of fish calendar

	File Name	Comment
Hydropower		
Data		
Review of data		
What data is needed in future		
Data collection forms		
Manuals		
Guidance Notes & Technical Reports		
	Guidance Notes for Hydropower Spreadsheet draft0.doc	
	Iraq hydropower potential draft_BLB formatted.xls	
	Proposed Water Allocation Model.doc	
	simple water allocation model V1.0.xls	
Calculation workbooks		
Map products		
Models		
Reference Library		
References		
Useful web links		
Training materials		
Presentation material from visits		
Best Practice Case Studies		

	File Name	Comment
Water Resources Modelling (largely HEC products)		
Data		
Review of data		
What data is needed in future		
Data collection forms		
Manuals		
Guidance Notes		
Calculation workbooks		
Map products		
	Iraq ResSim Nodes.pdf	

	File Name	Comment
Models		
Reference Library		
References		
Useful web links		
Training materials		
Presentation material from visits		
Best Practice Case Studies		

	File Name	Comment
GIS and Remote Sensing		
Data		
Review of data		
What data is needed in future		
Data collection forms		
Manuals		
Guidance Notes		
Calculation workbooks		
Map products		
Models		
Reference Library		
References		
Useful web links		
Training materials		
Presentation material from visits		
Best Practice Case Studies		

	File Name	Comment
Miscellaneous (met,….)		
Data		
Review of data		
What data is needed in future		
Data collection forms		

	File Name	Comment
	Meteorological Data Request.doc	
	Met data collection status record sheet.xls	
Manuals		
	Communication Ver 4 User Guide.pdf	
	Documents Ver 4 User Guide.pdf	
	Forum Ver 4 User Guide.pdf	
	People Ver 4 User Guide.pdf	
	Planning Ver 4 User Guide.pdf	
	Publish Ver 4 User Guide.pdf	
Guidance Notes		
G Nott	MMIRAQ~1.DOC	Stakeholder participation
Calculation workbooks		
Map products		
Models		
Reference Library		
References		
Steve Warren talk	Report_Turkey,Water and the Middle East.pdf	Trans-boundary rivers, particularly Tigris-Euphrates
Steve Warren talk	Helsinki WQ&H protocol.pdf	
Steve Warren talk	Helsinki.doc	
Steve Warren talk	ICPDR Konventionstext(98c13901).doc	
Steve Warren talk	International water resource allocation agreements.doc	
Steve Warren talk	Status of the Watercourse Convention as of 1 December 2000.htm	
Steve Warren talk	UN_conven_vs_Helsinki.pdf	
Steve Warren talk	United Nations Convention on the Law of the Non-navigational Uses of International Watercourses.htm	
Steve Warren talk	WFD.doc	
Useful web links		
G Nott	Refs.doc	Stakeholder participation links
Training materials		
Gugs	1-D Hydraulicand WQ Models.ppt	Theory behind models
Presentation material from visits		
G Nott	MMIRAQ~1.PPT	Stakeholder participation
	Water Framework Directive Presentation_Jon Pavey.ppt	

	File Name	Comment
	Global Water Partnership Presentation_Tom Brabben.ppt	
Best Practice Case Studies		
	International Rivers Presentation_ Steve Warren.ppt	